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ABSTRACT

Two abstracts and seventeen papers on educational information systems presented at the Association for Educational Data Systems (AEDS) 1976 convention are included in this document. An article describing the evolution of information systems provides an overview of educational data systems. Seven articles concern the implementation and use of information systems by educational administrators: five of these articles focus on public schools and school districts, and two articles focus on higher education. A computer model for simulating faculty flow and salary schedules in higher education is also presented. Two papers describe uses of minicomputers, one for student record keeping and one for predicting resource requirements. A low cost approach to on-line computer systems is presented in one paper, and seven papers describe the use of the computer in salary schedule evaluation, program budgeting and accounting, pupil information, studies of school attendance and attendance boundaries, and test scoring and reporting. (CH)

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EDUCATION INFORMATION SYSTEMS. Papers presented at the Association for Educational Data Systems Annual Convention.

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ASSOCIATION FOR EDUCATIONAL DATA SYSTEMS

The 1976 AEDS International Convention

Proceedings

TODAY'S REVOLUTION: COMPUTERS IN EDUCATION

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THE MINICOMPUTER IN STUDENT ACCOUNTING IN THE HIGH SCHOOL

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ABSTRACT: Minicomputers are being used for student accounting including preregistration, scheduling, attendance, grading, and bookstore systems in high schools of approximately 2000 students. A hardware configuration of card reader, matrix line printer, video display and keyboard, central processing unit, and a fixed and removable disc on one disc drive is operated by school secretarial and clerical personnel supervised by a local school administrator, and programmed by district programmers. Minicomputers in five high schools averaged 100 hours per month per minicomputer for all applications, with peak periods during April and October and slow periods during June and July.

THE PROBLEM

Which system of data processing is best for student accounting in a district of several high schools? This question is answered for a high school district of eight high schools with a total student population of 16,000 students and faculty of 700 teachers. The solution to the problem is to use independent minicomputers at the local school sites and was arrived at by trial and error carried out on a prove-that-it-works basis in one school before acceptance by other schools. The history of the solution of the problem is followed by a description of the hardware configuration, use of personnel, systems, usage for a calendar year, conclusions, and recommendations.

HISTORY

School administrators' increased demands for error-free, real-time computer services has resulted in a transition from centralized data processing to decentralized data processing in the Glendale (Arizona) Union High School District.

After an abortive experience with outside computer services to accomplish student accounting by computer during 1971-72, only one school agreed to experiment with a prepunched class-card system offered by a service bureau for the 1972-73 school year.

The 1972-73 academic year began with counselors and administrators effecting scheduling and schedule changes by filling in forms provided by the service bureau. The inability to detect errors made while filling in forms caused many inadequate printouts of schedules, rosters, and grade reports.

Somewhat frustrated, counselors, administrators and office staff solved the error detection and correction problem by accomplishing schedule changes and error correction at the school site using an 026 keypunch.

Turnaround time, another problem, was improved by purchasing computer time from a local industry on the second and third shift. Drawers of class-cards were removed from a twenty drawer file and transported to the computer facility for processing. District personnel programmed and operated the computer.

Upon consideration of the improved service (resulting from the purchase of computer time), administrators in two additional schools selected to use the computer during the next year, 1973-74. The data base was increased from merely student names and class schedules to personal information which was printed on the same card as the student schedule.

Although many of the problems of error detection and correction had been eliminated and turnaround time improved, the desire for real-time processing became apparent, especially for attendance reporting and schedule changes.

Three possible alternatives were studied: Lease of a large computer to be located in the district office; lease of remote printers and data input terminals for the schools, along with a centralized processor in the district office; or lease of minicomputers for each of the schools, where input terminals, printers, and processors would be operated by school staff.

The first alternative was rejected because it would mean a return to inadequate turnaround time. The second alternative was rejected for lack of redundancy in the central processor--if the central processor failed, all schools would be out of service. The third alternative was selected after a thorough and lengthy study of minicomputers--and experimentation with one minicomputer during the spring semester of 1973-74.

The experiment was accomplished with one BASIC/FOUR minicomputer system installed in one school for a rental period of six months.

Testing of the minicomputer applications to the attendance system from February through April was an outstanding success. Administrators in five of the eight high schools asked for BASIC/FOUR minicomputers for 1974-75. Scheduling, grading, bookstore, and preregistration systems were added as the year progressed. By February 1975, administrators in all eight schools asked for the minicomputers.

PROCEDURES

The minicomputer in a high school is operated and scheduled independently of other schools and the central office, however, central office personnel train local school personnel and program the minicomputers.

The hardware configuration shown in block diagram in Figure 1 is a BASIC/FOUR Model 350 data processing system. The Video Display Terminal includes a keyboard for data entry and a video display for character display transmitted from the Central Processing Unit at a rate of up to 240 characters per second. The CPU is a microprogrammed general-purpose computer with a 16K byte protected core memory in which the operating system software is resident. The CPU has 8K bytes of available user core memory. The Disc Memory Unit consists of a fixed disc and a removable cartridge disc on a single drive. Storage capacity of each disc is 2.1M bytes. The Medium-Speed Character Printer is a matrix printer with a printing speed of 165 characters per second, or 60 full (132 character) lines per minute. The Card Reader reads 80-column cards at a rate of 400 cards per minute. In addition to the BASIC/FOUR, an 026 keypunch is used to punch 80-column cards.

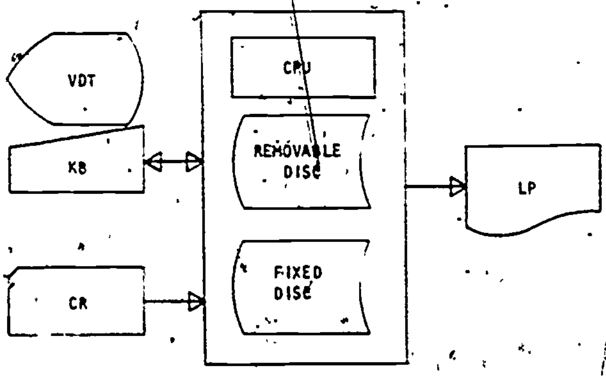


FIGURE 1. BASIC/FOUR MODEL 350 WITH CARD READER

Personnel

Records and attendance clerks and secretaries are given an inservice training program of three one-half days during the week before August registration. The purpose of the workshop is to familiarize participants with computer components, building computer files, and interaction of the operator with the computer via the VDT in effecting the scheduling, attendance, and grading systems. Classroom presentations are followed by actual practice on the computers in the schools. Although by-the-numbers instructions are developed for operators' initial use of the computer, operators are instructed to rely upon the instructions and questions appearing on the screen of the VDT, with the intention that the use of written instructions eventually becomes superfluous. The Assistant Principal for Student Services in a school maintains and supervises scheduling of computer usage for the school.

Systems design is accomplished by the district's Director of Data Processing working with the persons directly involved. Every attempt is made to consider the computer as a tool to help personnel accomplish their jobs easier and to develop new uses for the computer. The result is that initially the same outputs as the manual systems are generated, but with familiarity comes confidence and the willingness to modify old systems and develop new systems.

One district full-time programmer, two part-time programmers, and the Director of Data Processing accomplished the programming of the minicomputers for the first two years. A second full-time programmer was hired toward the end of the second year in order to insure adequate personnel when three more minicomputers are installed in the three remaining schools for the 1976-77 school year.

In addition to programming, programmers train new school personnel in the operation of the minicomputers and in correction of errors.

SYSTEMS

The systems presently operational are preregistration, scheduling, attendance, grade, and bookstore.

Preregistration

The Preregistration System is a system for capturing student subject requests and alternates for both semesters of the following academic year, and producing a preregistration request/alternate form for each student and a master schedule for the local school staff.

The system is initialized when the student circles desired subjects on a preregistration form showing all possible subjects. In addition, students fill in a personal information form on the opposite side of the list of subjects. Each preregistration sheet is checked and subject numbers, including requests and alternates, are recorded by a counselor, or assistant, in the lower right hand corner of the preregistration form. After checking, the school data processing controller keypunches a student name card, request card, and alternate card for each student.

The data processing controller reads these cards along with a set of subject name cards into the card reader to build files on a removable "preregistration" disc which contains all programs and files necessary to preregister students in a school of approximately 2000 students. These files are then used to produce course tallies, grade level and period loading, a conflict matrix, and lists of students by subjects requested and combinations of subjects requested.

The assistant principal uses these various reports to aid in the development of a master schedule. When the master schedule has been completed, a two-part student request/alternate form is printed for each student and used as input to the Scheduling System.

Scheduling

The Scheduling System is a system wherein student name cards, student request/alternate cards, and the master schedule are input and printed student schedules are output.

The system is initialized when a master schedule deck of cards is keypunched by the school data processing controller. Each card contains the subject number, section number, teacher name, room number, credit, track, and semester for each subject in the master schedule. The deck of cards is sorted by period and reproduced forty times with color coded "class cards" for each period. The cards are again sorted to obtain a set of class cards for each subject and section.

Considering a list of subjects offered each period, the student formulates first and second choice schedules on the lower part of the Student Alternate/Request form.

A student's schedule--preferably the first choice--is built by placing a class card for each subject requested behind the student name card. A clerk checks the cards against the student's Request/Alternate form.

Sometime before these cards are read into a disc file, a counselor number card is inserted behind the student name card. During May and June, student personal information is keypunched into six cards. These cards are read into a disc file of personal information on the same disc as the student schedule file and the master schedule file. This disc is called the Student Master Disc.

Seven hard copies of student schedule and personal information cards are printed during August and as new students enter school throughout the semester. New schedules are printed also when students have schedule changes.

Attendance

The Attendance System input is prepunched attendance cards containing student number, student name, teacher name, period, subject and section number, and semester. Each teacher receives a complete set of attendance cards for each class, inserts attendance cards for absent students in an envelope, and places the envelope on a clip near the door, or at a station, to be picked-up by an attendance office runner each period. These cards are read into the computer and returned to the teachers' mailboxes before the end of the day.

Each period, the attendance office clerk prints three reports on the minicomputer. The first report is a list of students reported absent for that period, providing that is the students' first period of the day. The second report is a list of students who have been present the periods before this period but are reported absent this period.

The third report is a list of students who are absent the periods prior to this period but are not reported absent this period. Parent names, addresses, and telephone numbers are included in these reports to help attendance clerks making calls to students' homes.

At the end of the day, an attendance clerk produces an aggregate report showing every student absent one or more periods, the day's attendance pattern for each student, parents' names and telephone numbers, counselor names and the ADA periods for each student.

Two attendance reports are printed at the end of the month. The first report provides a profile of a student's attendance by day and period of the day. The second report provides statistics depicting the accumulation of student absences by grade level, and is used in preparation of the State ADA/ADM report.

Grading

The Grading System has student grades as input and report cards, grade distributions, and permanent record labels as output.

The teacher marks the student's grade on the attendance card on the last day of the semester. Grades are sorted manually into 1's, 2's, 3's, 4's, 5's, 6's, and 7's, and entered through the card reader into the students' grade file on the Grading System disc. Corrections are accomplished interactively through the VDT keyboard.

A roster showing students and grades is printed for each teacher and is used to verify grades. After verification and a short period for corrections and changes, grade distributions are printed showing frequencies and percentages for each teacher by subject and total. Then, permanent record labels are printed and attached to students' permanent record cards.

Bookstore

The Bookstore System has two elements: a bookstore form for each student at preregistration in August and accounting of all school activity funds.

The student bookstore form is printed from data in the student schedule, personal information, and master schedule computer file which contains prices of books, materials, and fees for each subject and section.

School activity funds are updated periodically through the VDT keyboard. The bookstore manager or assistant produces a report on the financial activity at each update, a report of activity by account number upon request, and a monthly cash analysis summary.

COMPUTER USAGE FOR ONE YEAR

The average number of hours the five minicomputers in five high schools were used for each system during the calendar year 1975 is shown in Tables 1 and 2.

TABLE 1. AVERAGE NUMBER OF HOURS (ALL USES) PER MINICOMPUTER FOR THE MONTHS OF JANUARY THROUGH JUNE 1975

SYSTEM	MONTH J	F	M	A	M	J
Preregistration	-	1	17	27	22	1
Scheduling	34	25	12	25	11	30
Attendance	35	48	54	68	69	21
Grading	18	1	11	1	9	5
Bookstore	3	1	1	2	2	3
Other	12	14	17	17	13	11
TOTAL	102	90	112	140	126	71

TABLE 2. AVERAGE NUMBER OF HOURS (ALL USES) PER MINICOMPUTER FOR THE MONTH OF JULY THROUGH DECEMBER 1975

SYSTEM	MONTH J	A	S	O	N	D
Preregistration	-	-	-	-	-	-
Scheduling	51	86	50	43	28	31
Attendance	-	-	62	68	60	52
Grading	1	-	-	11	5	1
Bookstore	2	8	2	2	5	5
Other	5	9	9	20	11	8
TOTAL	59	103	123	144	109	97

Inspection of the tables reveals that the Preregistration System was accomplished beginning in February, peaking in April, and finishing in June.

Scheduling which consists of assigning students to classes and changing schedules was continuous throughout the year with peak periods during July, August, September, and October, and slow periods during March and May.

The Attendance System was non-operative during July and August, had little activity during June, and was fairly uniform through the remainder of the year.

Grading was accomplished during January, March, May, and October, with no activity during August and September. Grading accomplished during the months of February, April, June, July, November, and December consisted of correction of grades, printing permanent record labels, and grade distribution reports.

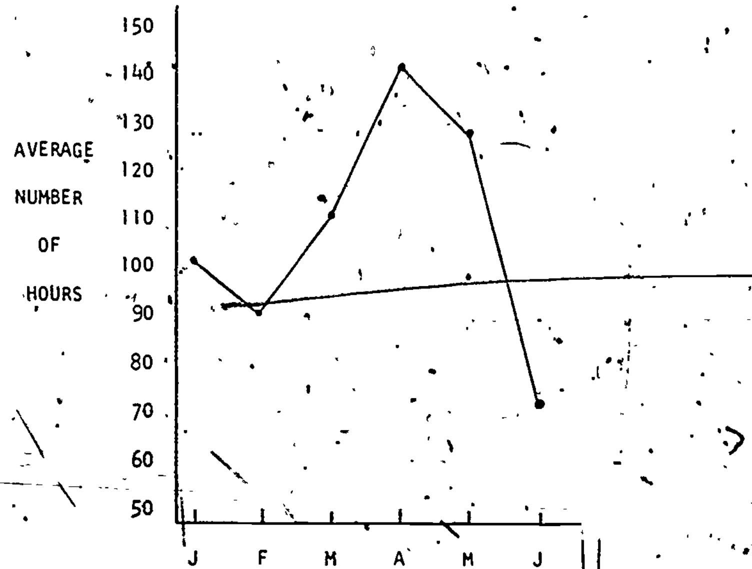
Bookstore activity was fairly uniform over all months with the exception of August when the student bookstore cards were printed. The other months of the year were devoted to activity fund accounting.

The "Other" category of usage includes testing, instruction, and programming. Testing was not systemitized within the schools during 1975-76, but will be systemitized in the schools during 1976-77.

Instruction using the BASIC/FOUR computer was developed experimentally in one high school during 1975-76.

As shown in Figures 2 and 3, when all uses are combined, the average number of hours used fluctuates sinusoidally around an average of approximately 100 hours per month per minicomputer, with maxima of over 140 hours during April and October and minima of approximately 90 hours during February and 60 hours during July.

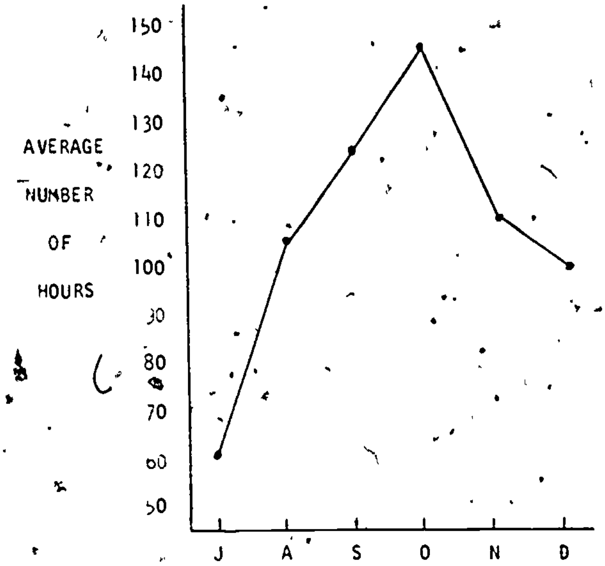
FIGURE 2. AVERAGE NUMBER OF HOURS EACH MINICOMPUTER WAS USED IN EACH SCHOOL FROM JANUARY THROUGH JUNE OF 1975



If an operational month is considered 20 days then five hours per day is an average operational day. Consequently, there were 7.00 and 7.20 hours per day in average operational days in April and October, respectively, and 3.55 and 4.85 hours per day in average operational days in February and June, respectively.

Experience has shown that five to six hours of operation is a full operational day. Therefore, operator hours were shifted to operate over a day extending from 7:00 a.m. to 6:00 p.m., with operation on Saturday at the end of each monthly attendance period.

FIGURE 3. AVERAGE NUMBER OF HOURS EACH MINI-COMPUTER WAS USED IN EACH SCHOOL FROM JULY THROUGH DECEMBER OF 1975



CONCLUSIONS

Consideration of the history of computer applications and accumulated usage of student accounting systems suggests two major conclusions.

1. Student accounting can be accomplished on a minicomputer within local high schools of approximately 2000 students operating independently of a central office system.

2. Student accounting systems can be developed by district office personnel working in close coordination with local school administration and staff.

RECOMMENDATIONS

Experience gained with five minicomputers in five high schools suggests several recommendations for schools and school districts considering the acquisition of computers and computer personnel.

1. In addition to cost, acquisition of computer hardware should be based upon the experiences of both local school staff and central office staff.

2. The district administrator of data processing should have a broad experience in student accounting systems both manual and automated.

3. Development of a system should be accomplished at one school site before adoption by all schools.

4. A system should be essentially the same in all schools, but should also allow for local school ideosyncracies.

5. One full-time programmer should be hired for four or five high schools, with one or two part-time programmers for special assignments.

6. Local school administrators responsible for scheduling computer usage should be trained on-the-job.

7. Providing that a positive attitude exists, present clerical and secretarial school staff should learn to operate the BASIC/FOUR minicomputer.

MY SCHOOL - MY WAY

Raymond R. Libner

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It is possible to bring school and computer personnel together to initiate an exchange of concerns and ideas that can produce an excellent working relationship and an outstanding array of services to the school. What the school administrator and the computer specialist must recognize is that the school must "call the shots." The school administrator must take the position, "My School - My Way." An ideal situation occurs if the system can be operated with minimal specialist assistance, once the procedure has been established. At Elmwood Park High School in Elmwood Park, Illinois (1200 students) the system is operated essentially by the secretarial-clerical staff, under the direction of school administrators, with assistance from specialists only when new programs need to be written or existing programs amended.

It is possible to bring school and computer personnel together to initiate an exchange of concerns and ideas that can produce an excellent working relationship and an outstanding array of services to the school.

Ten years ago the principal of Elmwood Park High School in Elmwood Park, Illinois (1200 students) approached the director of data processing at the local community college and asked for assistance in initiating student scheduling at the high school. The principal was a neophyte in the use of computers. Thanks to the patience and interest of both persons, an evolution of planning ensued over the years, resulting in an impressive growth of computer services at Elmwood Park that has become a model for numerous other school districts in Illinois.

What the school administrator and the computer specialist recognized is that the school must "call the shots." The administrator took the position, "My School - My Way."

The computer specialist, today as years ago, needs to use his talents to improve the processes by which the school staff attempts to serve the students of the school. The most elaborate data processing system is a sham if it does not improve the educational process at the local level - the school building and the classroom.

Computer services at Elmwood Park High School have evolved over the past ten years - through a process of "learning by doing," from a point of the school's having no equipment and little knowledge of what could be accomplished, to a point of having its own mini-computer. The high school has an on-line data processing system that serves both the student functions and the financial functions.

Each of the programs has been developed at the request of the school administrative staff. Because the school administrators are experts in their field and because the data processing personnel are experts in their field the key to producing a successful and operational program is understanding each other's jargon. When the obstacle of differences in terminology or in subtle variations of definition have been overcome, the development of workable programs proceeds apace and provides the administrator with what he needs, rather than with what the computer specialist thinks the school needs (or what the specialist presumes he can pawn off on the district).

An ideal situation occurs if the system can be operated from day to day and year to year with minimal specialist assistance, once the procedure has been established. At Elmwood Park High School the system is operated essentially by the secretarial-clerical staff, under the direction of school administrators, with assistance from specialists only when new programs need to be written or existing programs amended.

Most of the hardware at Elmwood Park High School is situated in a small, cubicled area (9 ft. x 20 ft.), adjacent to the principal's office. It consists of:

I. Keypunch - Genesis I

II. Card Reader - Four Phase Systems, Inc.
   A. Hopper and Stacker (1000 cards)
   B. 300 Cards Per Minute

III. Tape Drive - Four Phase Systems, Inc.
   A. 1600 Bits Per Inch

IV. Disc Drive - Four Phase Systems, Inc.
   A. 50 Million Bytes (50 Megabytes)

V. Core - 72K

VI. Printer - Four Phase Systems, Inc.
   A. 600 Lines Per Minute

VII. Interactive Video Display Terminals (5)
   A. Connected Between High School Building and Adjacent District Office
   B. Located on the Desks of the Secretarial-Clerical Staff Responsible for Specific Functions

Most data are handled via the video display terminals. The card reader is utilized to enter program instruction data into the system. Information is available to the staff via the terminal and/or via hard copy from the printer. The disc drive provides data storage and daily access, with back up security made possible by the tape drive. The computer language used at EPHS is COBOL.

Software services are provided by data processing specialists with Midwest Systems Group, Inc. of Downers Grove, Illinois. Their personnel include professional educators and technicians who are constantly reminded of the district administrator's premise, "My School - My Way."

The full range of services available to Elmwood Park High School and to Elmwood Park Community Unit School District 401 is listed as follows:

STUDENT ACCOUNTING

I. Student Scheduling

   A. Management Listings

      1. General Information
         a. Alphabetical Sequence
         b. Year-in-School Sequence
         c. Birthdate Sequence
         d. Counselor Sequence
         e. Homeroom Sequence
         f. Disaster Station Sequence
         g. Locker Number Sequence

      2. Disaster Stations
      3. Homerooms
      4. Counselors
      5. Address Labels
      6. Random Number Lists and Labels
      7. I.D. Cards
      8. Locker Assignments

   B. Scheduling - First Semester

      1. Keypunch Basic Data at EPHS
      2. Diagnostic and Initial Scheduling Operating at IBM 360 Facility (Off-site)
         a. Course File
         b. Teacher File
         c. Student File
         d. Tally
         e. Potential Conflict Matrix
         f. Reverse Verification
         g. Pre-scheduling Edit
         h. Main Scheduler
         i. Master Schedule File
         j. Student Reject Listing
         k. Student Schedule Listing

      3. Transfer Data Via Tape to Four Phase at High School

   C. Scheduling - Second Semester

      1. Modified College-Type Self-Registration
         a. "Protect" Student Seats in All-Year Courses
         b. Permit Changes in Schedule As Seats Are Available in New or Continuing Courses
      2. Process all Data On-Site on Four Phase Equipment

   D. Printing Operations

      1. Student Schedules
      2. Class Lists
      3. Count of Seats
         a. Course Order
         b. Teacher Order
      4. Room Utilization
      5. Teacher Utilization
      6. Student Receipt Report

II. Grades

   A. Grade Scanning Sheets
   B. Class List Proof Sheets w/Grades
   C. List of Students Who Did Not Receive a Grade for Any Class
   D. Print Grade Reports
   E. Transcript Labels

      1. Grades
      2. Credits
      3. Semester Grade Point Average
      4. Cumulative Grade Point Average
      5. Attendance

III. Reports and Summary Listings

   A. Report Cards
   B. Honor Roll
   C. Failure Lists
   D. Incomplete Lists
   E. Condition Grade Lists
   F. Medicals
   G. No Grade Lists
   H. Audit Grade Lists
   I. Withdrawal Lists
   J. Grade Distribution Lists
   K. Rank In Class
   L. Disadvantaged and Handicapped Report
   M. Driver Ed State Report
   N. Staff Roster
   O. Student Telephone Directory
   P. Library Film Reports, Lists, and Labels
   Q. District-Wide Labels (Sorts for one per family)

IV. Attendance Reports and Lists

A. Daily Attendance Scan Sheets
B. Daily Attendance Worksheet

1. Absences and tardies for each mod all day

C. Absence Roster

1. Basis for daily attendance record for teachers
2. Informs who was excused, unexcused, absent for full day or part

D. Monthly Attendance Detailed Listing

1. Lists each student with any absences, specific days absent, and whether excused or unexcused

E. Monthly Attendance Summary
F. Beginning and Ending Mods Matrix

1. This job control reorganizes mod times for students with changes in their schedule

V. Updating Capabilities on CRT Terminals

A. Student General Information (name, address, phone, parent name, locker number, disaster station, homeroom, birthdate, year in school, sex, grade school origin, total minutes attending school, disadvantaged and handicapped codes, total 6-week grading period absences)
B. Scheduling

1. Add and Delete course from student file and also from student schedule
2. Display Class Lists

C. Grades
D. Credits
E. GPA's
F. Attendance
G. PRS-Prints whatever shows on the terminal screen

FINANCIAL ACCOUNTING

I. Reports and Summary Listings

A. Master Transaction Listing - Beginning of Fiscal Year

1. Purchase Order Number Order
2. Account Number Order

B. Current Transaction Listings (Each separate account by Batch Number)
C. Budget File Listings - All accounts and balances of each
D. Program Budget Listings - Sub Program Order
E. Daily Transaction Run

1. Print Purchase Orders
2. Daily Transactions Entered

F. Account Activity Analysis
G. Statement of Revenue and Expenditure
H. Financial Statement
I. Account Dictionary
J. Receipt Report
K. Insurance Report

1. Alphabetical Order
2. School Order
3. Department Order

L. Inventory Listings

1. Inventory Number Order
2. School Order
3. Room within School Order
4. Classification Code Order
5. Description Order
6. Description within School Order

II. Bill Listings

A. Annual Bill List (Beginning of Fiscal Year)
B. Monthly Bill List
C. Paid Bill Labels

III. Vendor Listings

A. Vendor Order
B. Vendor Order with Remittance Address
C. Vendor Labels
D. Alphabetical Vendor File Cards

The services enumerated have evolved from small beginnings. Ten years ago the computer specialist at the community college performed a valuable service to one of the underlying high schools by installing a premise in the mind of the school principal: that the use of data processing should be at the command of the user.

"My School - My Way" focuses the spotlight on the school, not on the computer. The user is in control of the system.

PLANNING AND IMPLEMENTATION OF
MANAGEMENT INFORMATION SERVICES
FOR SCHOOL DISTRICTS IN MINNESOTA

Jack B. Hoffman
Coordinator/MIS Planning & Implementation
MECC

ABSTRACT: The ambitious project of providing school districts management information services (MIS) in Minnesota is being accomplished by Minnesota Educational Computing Consortium (MECC). Some of the questions to be answered are: What is MECC?; What are the system development plans?; How will MIS be implemented?

ORGANIZATION

Minnesota Educational Computing Consortium was established to provide computing facilities and support staff to serve the needs defined by education, and available equally to all students and educational institutions in Minnesota. Regular membership in this consortium consists of educational systems which, in their joint jurisdiction, represent all of the public educational entities in the State of Minnesota. These include: the Minnesota State Department of Education (SDE) representing public elementary, secondary and vocational (ESV) education; the State Junior College System, the State College System and the University of Minnesota, representing public higher education. The State Department of Administration is also a member of MECC. Hereinafter, these will be called the "member systems". In addition, private educational institutions can use services of the consortium.

The MECC Board of Directors is representative of the joint powers agencies with two members from each of the public higher education agencies; six members from the Department of Education (representing elementary, secondary and vocational education); three members are appointed by the Governor and one member appointed by the Commissioner of Administration. The private education sector is represented by one of the Governor's appointees.

RATIONALE FOR THE CONSORTIUM APPROACH

The concept of forming an educational computer services consortium was a logical extension of planning efforts which occurred over the past several years. Earlier planning reports stressed the need to view computing and information systems in the context of the complete continuum of educational levels, elementary/secondary/post-secondary. The need to do this has grown as computers and information systems assume increasingly more significant roles not only in the processes of instruction and research within educational institutions; but also in management and administration of these institutions. This need for comprehensive planning and sharing of resources by education at all levels has been accentuated further by the growing technological and economic feasibility of communication networks which permit interconnection of computing terminals and facilities throughout the State.

PURPOSE OF THE CONSORTIUM

In meeting the general objective of the organization as stated above, the specific purposes of MECC in serving the member systems are as follows:

- To ensure effective computer services to all students and faculty where a computer is needed either as a tool or an object of instruction.
- To ensure effective access to computing and information services by faculty and students for research, where research is part of the academic program of an institution.
- To assist the systems of education and various coordinating agencies in providing meaningful information which will be used in formulating effective educational policies by governing boards and the executive and legislative branches of government.
- To provide effective management information services (MIS), including

administrative data processing, for the management of education and educational resources at all levels. The remainder of this report will address MECC-MIS.

REGIONS

The implementation of Elementary/Secondary/Vocational (ESV) Management Information Services (MIS) will be completed on a regional basis. This concept keeps governance closer to the user, a definite concern of most districts. In addition, the logistics of delivering services to the districts becomes more realistic.

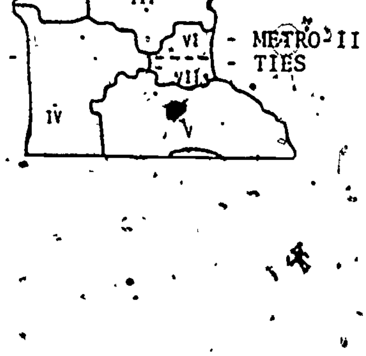
Of the seven regions which have been created, two encompass the Minneapolis/St. Paul metropolitan area with the other five servicing non-metropolitan or out-state regions.

Four major factors considered in defining the regions were:

1. Geographic
2. Number of districts
3. Number of students
4. Presently existing organizations

One of the two metropolitan regions, TIES (Total Information Educational Systems), has been in existance since 1968. Presently there are 45 districts with enrollment of 250,000 students utilizing their service.

The other metropolitan region, METRO II, has five of the largest districts as members. The non-metropolitan regions have established regional governing boards. These boards have selected Regional Directors and 3 of the 5 non-metropolitan regions are staffing in preparation for becoming operational.



REGIONAL READINESS SURVEY

In 1974 the SDE and MECC conducted a study to help determine the feasibility of establishing regional management information services centers. The five non-metropolitan regions had each of their districts complete the MIS survey. Each region then submitted the completed surveys to MECC, which in turn wrote a regional survey report.

The regional "readiness" survey report was intended to provide information to school district administrative officials, the regional boards, the SDE, the MECC Board of Directors, and the legislature.

For each region, the specific objectives of the survey were:

1. To ascertain the current status of MIS;
2. To determine current plans and priorities of school districts for obtaining MIS services;
3. To document the school district administrators' attitudes, interests, and concerns regarding factors related to cooperative MIS arrangements.

About 70% of the non-metropolitan districts were interested in regional MIS centers; 10% were not interested; and 20% were non-committal. Interest in the metropolitan regions was 100%.

ESV STEERING COMMITTEE

During the fall of 1974, the State Department of Education established the ESV Steering Committee. Each of the seven MECC regions designated representatives to attend these bi-monthly meetings.

The responsibilities and duties of the Steering Committee are to provide advise and/or make recommendations to the SDE concerning:

1. Policies and procedures for statewide MIS services.
2. School district information and data processing requirements.
3. Regional approach and alternative approaches to providing management information services.
4. Annual and biennial budgets and plans for management information services.
5. The coordinated development of common applications software and systems for regional service

centers.

6. Statewide data and reporting standards.

7. Statewide training and user services coordination.

The following five policies were adopted:

1. There should be one comprehensive and flexible elementary, secondary, and vocational (ESV) statewide management information system with an integrated data base defined such that, a mandatory subset of the data elements would be defined by the SDE, and a second subset would be defined statewide with optional regional or local usage.

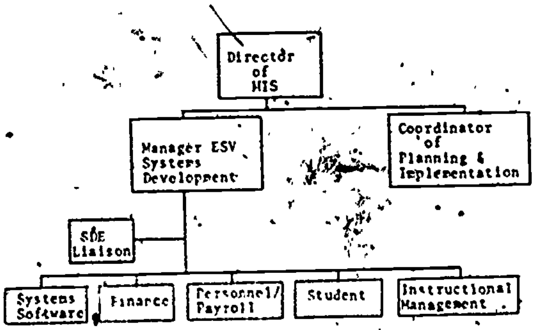
2. The State Board of Education's ESV Steering Committee should have responsibility for the review and approval of systems specifications and for setting priorities for system development and revisions.

3. MIS development in accordance with 2. above, should be accomplished through a single statewide effort under the aegis of the State Department of Education.

4. The common system to be developed should use, as a point of departure, the currently existing software system serving the TIES consortium. The TIES software should be modified to include other significant application packages such as those existing in METRO-II and other regions.

5. The common system should be designed in such a way as to facilitate equitable bidding in accordance with state statutes.

MECC-MIS ORGANIZATION



The Manager of ESV Systems Development has the responsibility for supervision of the staff, in addition to the development effort.

The system software group and each of the functional areas (e.g., Finance, Personnel/Payroll, etc.) have a team leader. The SDE liaison, a MECC employee, coordinates the SDE needs with the other functional areas.

Statewide functional area advisory committees have been established. The advisory committees have at least one representative from each of the seven regions. The regions also have advisory committees for each functional area.

The Coordinator of Planning & Implementation works with the seven regional boards in evaluating needs and in determining the implementation plans for the regions. The coordinator also has a small staff of training specialists to assist the regions during implementation.

WORKSHOPS

Since January, 1975, there have been five types of MIS training workshops conducted around the state. They were:

- TIES Pilot Districts
- SDE/MECC Regional Planning
- SDE/TIES MIS
- Minnesota Association of School Business Officials (MASBO)
- Regional Functional Area Workshops

The SDE contracted with TIES to deliver services to four districts in rural Minnesota. These four districts are known as the TIES pilot districts. These districts have conducted workshops on specific applications or services (e.g., Personnel/Payroll, Student, etc.). Staff from other districts who were interested in these specific areas were encouraged to attend. Each of the pilot districts was assisted by the TIES service staff in presenting six half-day sessions.

Six regional workshops were conducted cooperatively by MECC and SDE. The objectives of each workshop were: (1) to inform participants of the status of MIS development in Minnesota, (2) to present basic MIS concepts, and (3) to provide information for making a decision on regional MIS centers. The agenda for these one day workshops included: an update on instructional timesharing, SDE/MECC/ESV regional relationships, computer and MIS concepts, MIS survey results, uniform financial accounting and reporting standards (UFARS), statewide MIS planning. UFARS is a structured budgetary accounting system that will be used by all school districts in Minnesota.

In 1974, TIES staff conducted two 2-1/2 day MIS workshops to provide superintendents with an opportunity to become familiar with MIS. These workshops were repeated in 1975 to reach superintendents who were unable to attend the previous year.

In March, 1975 MASBO sponsored a workshop dealing with implications of MECC on school fiscal management. This two-day event was aimed at those persons who have day-to-day responsibility for fiscal management activities.

During September and October of 1975, regional functional area workshops were conducted in the non-metropolitan regions in the State. This gave district personnel an opportunity to interface directly with the key individuals in each functional area.

SYSTEMS DEVELOPMENT

One of the more important effects of the principles adopted by the ESV Steering Committee is the initiation of a "state-level" common effort to provide system software and administrative application programs. It is the intent of the system development staff to provide a well documented, flexible and expandable statewide system.

An advantage of this approach is that it represents a systematic method for providing management information services for all the school districts in Minnesota. Related to this are potential benefits to be realized from economies of scale achieved in utilization of compatible hardware and systems. Comparability, timeliness and accuracy of information reported to state and federal agencies will also be a major benefit of statewide effort.

The basic model for the statewide ESV-IS is the existing TIES system. Additional conceptual and design enhancements will be based upon efforts accomplished by METRO-II and other regions.

The system development staff is using a project control system called PRIDE (PRofitable Information by DEsign through Phased Planning and Control) which was developed by M. Bryce and Associates, Inc. The PRIDE system is broken down into the following phases:

1. System Study & Evaluation
2. System Design
3. Sub-System Design
4. Procedure Design - Administrative Computer
5. Program Design
6. Computer Procedure Test
7. System Test
8. System Operation
9. System Audit

During the next year, major emphasis will be placed on implementing the ESV-IS at METRO-II (Minneapolis, St. Paul, Robbinsdale, Mounds View and Vo-Tech 916 districts). Three non-metropolitan regions will be establishing regional service centers to start operations in July of 1976. The other two non-metropolitan regions will be establishing service centers to start operations in January of 1978.

The SDE will be developing their internal MIS during the next year.

HARDWARE ACQUISITION

The task of identifying the system hardware requirements involved a process of analyzing a previous requirement study conducted by METRO-II and TIES in addition to input received from other technical and user staff.

Care was taken to insure that the bid specifications conformed to State procurement statutes and related to a wide range of regional computing alternatives.

After the preparation of the bid specifications, the State Department of Education, the MECC staff and various advisory groups reviewed the specifications from a technical standpoint. The specs were also critiqued by a private consulting firm, A.D. Little and Associates. Upon approval, the bid specifications were released to all major vendors on the state bidder's list.

The bids for the computer systems were received and evaluated by the ESV-IS Bid Evaluation Task Force, consisting of representatives from the MECC membership and the MECC consultant Arthur D. Little, Inc., This evaluation process included question and answer sessions with technical representatives of each bidder.

The MECC Board recommended approval of the bid award, upon verification that the systems bid will perform as specified prior to final bid award. This performance verification should be accomplished by analysis of the operation of systems very similar in hardware and software configurations to that anticipated by the ESV-IS.

The performance verification was completed by visiting four Burroughs installations that have comparable systems. Contracts with Burroughs have been completed.

SUMMARY

The concept of a statewide computer consortium in the educational environment is a reality in Minnesota. This report described the evolution of MECC and more specifically addressed the planning and implementation of MIS in the school districts.

A FACULTY FLOW MODEL

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Miami-Dade Community College, Miami, Florida 33176

ABSTRACT: The model is a sophisticated simulation tool which can be used in gaming faculty flow, salaries and salary policies at institutions of higher learning for up to ten years in the future. Although specifically developed to meet the needs of Miami-Dade Community College (M-DCC), it was designed with sufficient flexibility to be useful to other colleges and universities.* Furthermore, the computer program for the model was written in American National Standard (ANS) COBOL so that other educational institutions and even companies can use the model with a minimum of modifications.

The Faculty Flow Model, developed recently at Miami-Dade Community College, provides insight as to the probable paths that faculty will take during the coming ten years. Once each year in the future, each individual faculty member is promoted, retired or terminated in accordance with personnel and salary policies and the cast of a random number. (Such policies, incidentally, can be modified on a year-by-year basis.) Considerable research was required to develop the "hard" data from the history of faculty flow in order to make reliable predictions. Also, standard actuarial data was used for determining the probability of death occurring in any one year, as a function of age and sex. Prior to exercising the model, an extract of the faculty personnel payroll file is made containing such critical elements as rank, age, years at the college, years in rank, sex and current salary.

Technically, the model is a modified Markov chain, Monte Carlo simulation. Programming was done in ANS COBOL so that the computer program could be adapted by other colleges and universities with minimum effort.

The purpose of the Faculty Flow Model is to provide decision makers with long range information concerning economic solvency. Thus executives at an educational institution can explore options and make decisions with enough lead time so as to avoid such catastrophic problems such as bankruptcy or insolvency. Stated in a more positive way, this model will permit upward adjustments to a salary schedule to be studied and declared economically sound prior to implementation. Accordingly, higher salaries of both remaining and new employees might be recommended then would otherwise be the case if no gaming had taken place.

Some of the more interesting possible policy changes that could be gamed are as follows:

1. What is the impact of imposing a hypothetical quota for each academic rank?
2. What is the economic effect of altering the mandatory requirement age?
3. What is the economic impact of changing the percentage of the total number of personnel permitted to be on a one year leave with pay?
4. What is the long range economic impact of boosting the ceilings of all present salary schedules?

An important acknowledgement must be given to Dr. Robert McCabe, Executive Vice President of Miami-Dade Community College, who developed the economic concept upon which this model is based. To understand this concept, consider an environment where the total dollars available for all salaries are, generally speaking, invariant with time, assuming a status quo enrollment and no inflation. In such a case, the total dollars required by paying increases to people on board must be obtained by new hires being employed at salaries less (or far less) than the salaries of the personnel whom they are replacing. (Obviously, changes in enrollment or consideration of an inflationary rate are complicating factors.) Using this concept, the model can be played two ways, so to speak: frontwards and backwards. In the frontwards version, the average salaries for new hires is an input, and economic solvency on a year-by-year basis is investigated. Played backwards, economic solvency over the period of time investigated (up to ten years maximum) is assumed as an input, and the salaries that can be paid new hires is determined by calculations.

It is believed that this model will make a significant impact in long range planning at Miami-Dade Community College, and it might do the same for other institutions which might choose to use it as a planning tool.

*In the following sections, the Faculty Flow Model will be referred to as the "Salary Solvency Model", the name by which the model is best known at M-DCC.

METHODOLOGY DISCUSSION

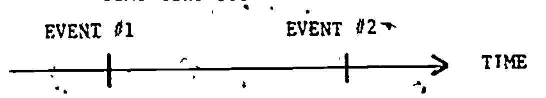
The Salary Solvency Model can be considered a "Modified Markov Chain, Monte Carlo Simulation." An explanation for this definition follows.

Markov Process

A time-line that is basic to an understanding of a Markov Process is given in Figure 1.

Figure 1

Time-line for a Markov Process



In a Markov process, changes (or "transitions") occur or can be assumed to only at one or more events. No changes occur between events. A second criterion for a process to be Markovian is that probabilities associated with an event are not dependent on the outcome of the preceding event.

Personnel practices such as hiring and terminating at a college were assumed to be Markovian for the purpose of this development. This necessary simplifying assumption was possible because of the negligible error introduced thereby. A Markovian process would assume that all events occurring during a year can be considered as having occurred at the same time, probably the beginning of the year.

In a Markov process, it is convenient to think in terms of "states" prior to an event and "states" following the event, with a "probability transition matrix" or "transition matrix" containing the probabilities of going from one state to the others when the event occurs.

To develop an illustration, an instructor will be considered who is at the institution before "Event #1." (Event #1 could, for example, be the beginning of the 1975-76 year.) The input state for Event #1 is thus simply "instructor." Typical output states of Event #1 would be as follows:

1. Instructor,
2. Assistant professor, and
3. Termination

The transition matrix for Event #1 is described in Figure 2.

Figure 2

Output State Probabilities
Considering One Input State

		OUTPUT STATE PROBABILITIES		
		Inst.	Asst.Prof.	Term.
INPUT STATES	Inst.	0.6	0.3	0.1

Each of the numbers above represents a transition probability. For example, the probability of the instructor being promoted to assistant professor is 0.3 (or three chances in ten).

Figure 3 was obtained by expanding the one input state transition matrix (Figure 2) to include "assistant professor" as an input state.

Figure 3

Output State Probabilities
Considering Two Input States

		OUTPUT STATE PROBABILITIES WITH TWO INPUT STATES			
		Inst.	Asst.Prof.	Assoc.Prof.	Term.
INPUT STATES	Inst.	0.6	0.3	0.0	0.1
	Asst. Prof.	0.0	0.7	0.2	0.1

Each zero in the matrix indicates that that particular transition is not possible. Each set of output probabilities is mutually exclusive and exhaustive, and the sum of all probability sets has to equal one.

It is often convenient to think of a series of events. This is the case with the Salary Solvency Model where ten events (or ten "year-beginnings") can be considered at maximum. When more than one event is involved in a Markov process, it is convenient to use the terminology "Markov Chain."

Modified Markov Process

Considering at Miami-Dade Community College all positions on all payrolls and all steps possible, there could likely be about 1,000 unique input states. This means that the full matrix for Event #1 only would be an astronomical 1,000 by 1,000 in size, thus requiring 1,000,000 cells for all probabilities.

It is customary in Markov processes to describe the entire transition matrix. However, because of the vast size of such a transition matrix (and the computer memory requirements therefor) and because of the fact that most cells would have a zero probability, a technique was used in which only the most likely transitions are considered. All other transitions are assumed to be zero. This is what is meant by a "Modified Markov Process."

This technique requires that categories of employees where promotions are likely be processed separately. Fortunately, the three payrolls at M-DCC (classified/staff, administrative and instructional) met this criterion for categorization. This development focused on the application of the Salary Solvency Model to the instructional payroll. In so doing, promotions or transfers from other payrolls to the instructional payroll and vice versa were assumed to be negligible with respect to gaming findings.

Monte Carlo Simulation

In order to lay the foundation for the next discussion, it was assumed that there were a hundred candidates for transition from an input state to output states for Event #1. In using a non-Monte Carlo (or analytic) simulation, the hundred candidates would be distributed to the possible outcomes as closely as possible to fit predicted outcomes.

When the number of candidates for any one probability cell is very large, a non-Monte Carlo (or analytic) simulation can be quite accurate. When the number of candidates for any one input state is, say, one, then the most likely outcome must be hypothesized in a non-Monte Carlo simulation. At M-DCC there are some 2,000 employees who are candidates for approximately 1,000 input states and a much larger number of probability cells -- considering Event #1 only. When one considers two or more events, the number of candidates for any unique sequence of events approaches zero in all cases! In practical terms, this means that a non-Monte Carlo (or analytic) simulation for this problem would become increasingly inaccurate after the second year. Thus a Monte Carlo solution was indicated.

In a Monte Carlo simulation, a random number is generated and used to decide the outcome of each probabilistic occurrence. In practical terms, random numbers are used in the Salary Solvency Model to predict the fate of each person going through the one to ten years of the simulation. For any one trial Monte Carlo run, these random numbers decide whether the person is promoted, terminates, dies, etc. The probabilities used for each of these occurrences should be based on the best historical and actuarial information available.

One full Monte Carlo simulation is never adequate to describe a process. Instead, usually many hundreds or thousands of simulations are computed, and the averages (or means) are used. In the Salary Solvency Model, the number of Monte Carlo runs desired for any one computation of means and standard deviations can be specified as an input parameter.

The principle disadvantage of a Monte Carlo simulation is that it is time-consuming on a computer because of the need for many interations. Through trial and error, the number of production runs can be optimized in the application of the Salary Solvency Model to produce a reasonable compromise between accuracy and cost of output. Standard deviations are especially useful in this optimization process.

When more than two output states are possible, the transition matrix, discussed earlier, must be converted to a table of "cumulative probabilities" so that a random number can indicate the outcome selected. Figure 4 illustrates the first transition matrix described in the preceding section (Figure 2) after conversion to a table of cumulative probabilities.

Figure 4

Matrix of Cumulative Probabilities

		OUTPUT STATE CUMULATIVE PROBABILITIES		
		Inst.	Asst.Prof.	Term.
INPUT STATES	Inst.	0.6	0.9	1.0

Assuming that a random number can be generated with a value of from 0 to 10 inclusive, any random number generated will be divided by 10 so that it can be considered a probability with a range of 0.0 to 1.0. Let z = random number. Then:

1. if $0 \leq z < 0.6$, the instructor is declared to remain an instructor at Event #1.
2. If $0.6 \leq z < 0.9$, the instructor is declared to be promoted to assistant professor at Event #1.
3. If $0.9 < z \leq 1.0$, the instructor is declared to be terminated at Event #1.

INPUT SPECIFICATIONS

The input specifications for the Salary Solvency Model can be categorized under three headings:

1. Run Identification and Miscellaneous Tables and Data Elements.
2. Personnel/Payroll Extract Data Elements.
3. Gaming Parameters.

The term "run identification" is self-explanatory. One of the required tables consists of mortality probabilities as a function of age and sex. Another input table consists of transition probabilities based on historical information. The data elements required include the "optional retirement probability by age", the "identity of the base year", the "total number of years being forecast", the "number of Monte Carlo iterations desired", and "a Monte Carlo seed number".

The following data elements pertaining to the personnel/payroll file have to be supplied in the form of the magnetic tape record for each full-time employee being investigated in the gaming run:

Element Description	COBOL Picture
Record sequence number (e.g., 143)	9(4)
Age (e.g., 47)	9(2)
Base annual salary (e.g., $14,936)	9(5)
Number of years at college (e.g., 9)	9(2)
Number of years in retirement plan (e.g., 11)	9(2)
Sex: M or F (e.g., M)	X(1)
Job Code (e.g., 5)	9(4)

This extract is produced from the master personnel/payroll file of the college. Developing this extract may involve some simple calculations. For example, "age" for the initial application of the Salary Solvency Model at M-DCC was computed using the run date and the employee's birthdate.

Unwanted records should be inhibited at the time the extract is made. For example, during the initial application of the Salary Solvency Model at M-DCC, all payroll records were inhibited except those for full-time employees on the instructional payroll.

For each year being forecast, the following data elements associated with gaming parameters have to be given:

Element Description	COBOL Picture
Year (e.g., 1975-76)	X(7)
Enrollment in terms of FTE students (e.g., 30,534)	9(5)
Leave percentage - - percentage of employees expected to be on a one-year leave with pay (e.g., 1.5)	9V99
Inflationary rate applied relative to the preceding year (e.g., 8%). A negative sign indicates deflation.	S99V99
Flag (Y or N)* indicating if salary minimum is to be adjusted upward corresponding to inflation (e.g., Y)	X(1)

*Y = Yes, N = No

Element Description	COBOL Picture
Flag (Y or N)* indicating if salary maximum is to be adjusted upward corresponding to inflation (e.g., Y)	X(1)
Flag (Y or N)* indicating if salary increment argument is to be adjusted upward corresponding to inflation (e.g., N)	X(1)
Mean age of a new hire (e.g., 33)	9(2)
Probability of any new hire being male (e.g., 0.50)	V9(4)
Mandatory retirement age (e.g., 70)	9(2)

The foregoing requirements also apply to the base year, in which case each element is optional except for "Year".

For each position type, the following data elements have to be furnished for the base year only:

Element Description	COBOL Picture
Job code (e.g., 1)	9(4)
Replacement job code (e.g., 4)	9(4)
Salary minimum -- to nearest dollar (e.g., $16,693)	9(5)
Salary maximum -- to nearest dollar (e.g., $22,958)	9(5)
Salary increment code; F or P (e.g., F)	X(1)
If Code F, salary increment argument is annual increment to nearest dollar (e.g., $540)	9(5)
or	
If Code P, salary increment argument is annual increment expressed as a percentage (e.g., 3%)	9(2)V9(3)
Quota (e.g., 75) A value of 99999 indicates an "unlimited quota" or "no quota"	9(5)
Enrollment constant A (e.g., 0)	9(5)
Enrollment constant B (e.g., 0.002718)	V9(6)
Number of open positions (e.g., 2)	9(5)

In addition, the "Percent of range" has to be given for any new hire.

*Y = Yes, N = No

OUTPUT SPECIFICATIONS

The output consists primarily of one or more pages for each year being forecast. One row of data elements is reserved for each position type, and the last row is reserved for totals (by year). Data elements printed out for each row of data are as follows:

Element Description	COBOL Picture
Job title	X(22)
Job code	9(4)
Replacement job code	9(4)
Adjusted quota	ZZ,ZZ9
Enrollment constant A	ZZ,ZZ9
Enrollment constant B	9.9(6)
Predicted mean number of new/remaining employees	ZZ,ZZ9.99
Predicted mean salary of new/remaining employees	ZZ,ZZ9
Adjusted salary minimum	ZZ,ZZ9
Adjusted salary maximum	ZZ,ZZ9
Salary increment code (F or P)	X(1)
Adjusted salary increment argument	ZZ,ZZ9
Predicted mean number of new employees	ZZ,ZZ9.99
Predicted mean salary of new employees	ZZ,ZZ9
Predicted mean number of surplus employees	ZZ,ZZ9.99
Predicted initial optimum number of new/remaining employees	ZZ,ZZ9
Predicted mean optimum number of new/remaining employees	ZZ,ZZ9.99

Standard deviations for selected data elements are printed on a separate data line immediately below associated data elements.

The format for the base year is identical to the format for the forecast years except that certain data elements not available are not displayed, and appropriate column headers are inhibited.

The output for each page or pages pertaining to any one forecast year contains the following data elements in the header:

Element Description	COBOL Picture
Title "SALARY SOLVENCY MODEL"	Not Applicable
Computer run date	Not Applicable
Run identification information	X(132) for each of two lines

Element Description	COBOL Picture
Year being forecast	X(7)
Enrollment	9(5)
Inflationary rate	X99.99
Leave percentage	9.99
New hire male/female mix	.9999/.9999
Mean age of new hire	99
Mandatory retirement age	9(2)
Number of Monte Carlo iterations	9(5)
Random number generator seed number	4(N)
Mean age of all employees	99.99
Mean number of years at institution	99.99

GROUND RULES AND ASSUMPTIONS

As the Salary Solvency Model was being designed, developed and tested, a number of ground rules and assumptions emerged:

1. Only full-time employees are considered. Temporary and part-time employees (including student assistants) are not included.
2. The financial impact of supplements, overtime and overload for full-time employees are not considered.
3. The financial impact of fringe benefits for full-time employees are not considered.
4. Instructional personnel who have "basic-year contracts" (10-month contracts) are assumed to have basic-year contracts for all projected years in the simulation, etc.
5. Any random-number-generated decisions made during any one forecast year are assumed to have occurred at the beginning of that forecast year.
6. As the Salary Solvency Model "hires" an employee for a year, he is not subject to any additional decisions for that same year.

INITIAL APPLICATION OF THE MODEL

Approximately 30 runs were made in order to validate the model thoroughly and to test its sensitivity to various parameters. This information (plus all computational algorithms) is contained in the author's doctoral dissertation, which is available at a cost of $15.00 from the Miami-Dade Community College Bookstore, 11011 S.W. 104th Street, Miami, FL 33178.

About 90 minutes of IBM 370/155 CPU time is presesently required for 100 iterations at M-DCC using the instructional payroll of some 1000 full-time faculty and forecasting for a full ten years. This program required 172,000 bytes of storage, and is written totally in ANS COBOL.

An improved version of the program producing identical data requires 60 minutes of IBM 370/155 CPU time and 164,000 bytes of storage, but the ANS COBOL program requires a subroutine in IBM 360/370 assembly language for the random number generator.

Unfortunately the gods conspired in an interesting way. About the time that the model became operational, the State of Florida imposed a salary freeze on all employees for one fiscal year beginning July 1, 1975. Concurrently, an enrollment ceiling was placed on all public institutions of higher learning. Therefore, although the Salary Solvency Model was used by the M-DCC administration to determine the impact of proposed salaries and salary policy changes for 1975-76, none of these changes could be implemented because of suddenly imposed constraints. It is anticipated, however, that this model will be extremely useful in the future.

CLUDING REMARKS

For institutions which have collective bargaining, the Salary Solvency Model should be particularly useful in determining the long range financial impact of proposals and counter-proposals.

The Salary Solvency Model can be purchased from M-DCC for $3,000.00 on a satisfaction-guaranteed basis. This purchase price includes a tape and/or card source-language program plus complete documentation. Implementation assistance is also available from personnel associated with the project through private consulting agreements. For further information, contact the Miami-Dade Community College Bookstore, 11011 S.W. 104th St., Miami, FL 33176, or contact the author at (305) 596-1328.

MINNESOTA
ELEMENTARY/SECONDARY/VOCATIONAL (E/S/V)-
MANAGEMENT INFORMATION SERVICES (MIS)
REGIONAL OPERATION

John E. Odom, Director
Elementary-Secondary & Vocational Educational
Region V Management Information Services Cooperative
Rochester, Minnesota

ABSTRACT: One of the first steps in the development of the statewide ESV-MIS network was to establish the regional centers. The organization and implementation of regional operations has undergone many transitional phases and is now becoming a service to its member school districts.

A. Organization

Region V covers Southeastern Minnesota and has approximately 23% of the state's school districts eligible to receive its services. The total student population in the region is 140,000 students.

The regional group which has been formed to provide the administrative data processing needs is the Elementary-Secondary and Vocational Education Region V Management Information Services Cooperative. Membership in the Cooperative is limited to public institutions within the region. Approximately 50% of the school districts have currently joined the Cooperative.

The regional Cooperative has a governance board which meets monthly. The governance board is made up of eight representatives, four superintendents and four school board members, from member school districts. Restrictions stipulate that no two of the eight representatives can be from the same district and must be selected from four general sizes of districts.

Initial funding was available to the region from the Minnesota State Department of Education (SDE) for planning purposes. The region then put together a preliminary plan which included a survey and successfully competed with the other four regions outside the Twin Cities metro area to be approved as one of three outstate regions for continuing funding.

Staffing for the region was begun during the Summer of 1975. Currently the region has four employees and will add two more over the next month.

School districts which are members of the regional Cooperative may contract for different types of services. A member district may decide to contract with the Cooperative for a specific service or may elect to take all the services which are offered. A service fee has been set for each application which causes this Cooperative to be somewhat different from TIES which charges a flat rate for services.

B. Implementation

The SDE had proposed to the state legislature that three outstate regions be funded with a subsidy in order to be able to bring up 12 to 15 districts in each region on an interim system. Like most things which are funded by state legislatures, the funding came through but not at the level the SDE desired. The SDE did select the three regions and the work was begun.

The first problem the regional group considered was that of selecting a site for the main offices and a computer facility. They asked the districts in the region to submit proposals as to the possibility of locating the site in their districts. Four districts prepared detailed proposals on possible locations. Many factors were weighed in the selection process and after the interim governance board had visited all the proposed sites, Rochester, Minnesota was selected as the best location.

A joint powers agreement and bylaws had been in the draft stages for about a year before a director was hired. His first job was to put the finishing touches on these documents. The process of writing, editing, and receiving board approval of changes made in the documents took about a month. These documents were then mailed by special delivery to Region V school districts in September, 1975.

A membership drive was mounted during October, 1975 to reach as many school districts as possible. The director attended school board meetings, met with school district staff, and called on many superintendents. There are 100 school districts in the region which caused some difficulty in arranging visits. To date there are still about 30% of the districts which have not been visited or have requested not to be included in any regional development plans at this time. The drive was successful from the standpoint that over 80% of the districts which were contacted have joined and 10% more have indicated that they will do so in the future.

The region was represented by the director in the development of the State Department of Education Implementation Plan. The Region V Governance Board approved the finalized Implementation Plan which was then approved by the SDE Elementary-Secondary and Vocational Education (ESV) Steering Committee. The SDE Implementation Plan calls for the statewide information system to be implemented by July, 1977 with continuing funding from the SDE directed to the region for this task.

The next step in the development of the regional Cooperative was to investigate the various alternatives available for interim services to be used until such time that the statewide information system was operational. The main alternatives were:

1. Contract with TIES to provide districts with the TIES system through a host satellite in the region.

2. Use the hardware and software already existing within the region.

3. Install a computer system in the region and implement financial and personnel/payroll systems using software acquired through the SDE.

Criteria was established to help determine which alternative was most feasible. One of the main considerations was the cost to the individual school districts. The cost could not be so high as to prohibit smaller districts from utilizing the interim services. At the same time, the services offered had to be attractive to enough districts to make it economically feasible. Another consideration was to try to develop in the direction that the statewide information system will ultimately be so that districts using interim services would have as little change as possible. It was also crucial to be able to show as much progress at the regional level in order to be in a better position to receive additional state funding in the next few years.

After extensive studies it was decided by the Region V Governance Board that the most feasible alternative was the third option which was to install a Burroughs 1728 computer system to be operational by July, 1976 and implement the two systems. The financial system incorporating the Minnesota Uniform Financial Accounting and Reporting System (UFARS) will be operational in July, 1976 with the personnel/payroll system operational by January, 1977. The student population base needed to make this option economically feasible was more than adequately reached and training workshops began in March for the seventeen participating school districts. The financial system will be running parallel with the district's present system in July until such time the district feels confident to switch over entirely.

The final conversion to the statewide information system will begin as soon as the software is available. The school districts utilizing the interim services in the next year will be among the first to convert. Additional districts will implement the system as desired. It is projected that 90% of the region's school districts will be using the services provided by the Cooperative by 1980-1981.

EXPERIENCES WITH OPTICAL MARK READING IN TEST SCORING, GRADE REPORTING, SURVEYS, INTERGOVERNMENTAL AGREEMENTS

Raymond P. Wisniewski

Phoenix Union High School System, Phoenix, Arizona 85017

ABSTRACT: The Phoenix Union High School District utilizes a page optical scanner to score tests for 78,000 students in the K-12 grade levels and processes surveys, questionnaires, and grade reports for 28,000 high school students. The main effort is in the basic skills areas of mathematics and reading. In order to handle the variety of grade levels, test input formats and types of tests, a General Purpose concept has been developed. One standard scanner sheet is used with the same set of programs to produce rosters, item analysis, and statistics for a variety of tests.

The Phoenix Union High School System consists of 11 high schools plus an Area Vocational Center with a total student population of 28,000. The district also services 13 elementary districts in the city of Phoenix with an additional 50,000 students. The district installed the NCS Sentry model 7015 scanner in February, 1973 primarily for student testing. The central computer system is a Honeywell 1250 Disk System.

The high school testing program centers around a return to the basic skills concept with the Minimal Reading and Mathematics Proficiency tests. By state regulation, students must attain a basic level of skill in these two areas prior to graduation. A third area, Writing Proficiency, is now in the process of development. Students take the original test and make-up tests required until they have passed 75% of all parts taken. The remainder of the secondary testing is made up of the Free Enterprise test (state requirement), Otis-Lennon, Iowa Test of Educational Development, Iowa Test of Basic Skills and our own General Purpose Testing.

I. GENERAL PURPOSE TESTING AND SCORING

Perhaps the most interesting area is the General Purpose Testing. Since all of the district testing is conducted and controlled by our Research and Planning Department, the variety of tests and surveys is extensive. The general objective was to establish a testing system that was flexible, economical, and fairly simple to control. Our specific aim was to use one standard form for any test or survey, have the ability to break the test into parts if required, the items to be sequential or random, score the tests, produce student rosters, item analysis and statistics with the minimum amount of programming effort. The basic input for the system is the General Purpose - NCS - Answer Sheet (Form P099B) which has a maximum of 240 items. All or part of the 240 items can be used for any test or survey and can be further divided into parts or sub-tests with a maximum of 20 parts. The parts may be made up of either contiguous or random items. For example Part I may be defined as items 1-10, Part II items 11-20, etc., or Part I may be defined as items 1, 14, 27, 36, 43, 51; Part II items 2, 16, 29, 38, 47, 55, etc. Up to four header sheets can be used to break various groupings (school, teacher, etc.).

The output produced by the system consists of the following:

1. Student Rosters (example B) - indicates student number, name and <u>incorrect</u> responses for each part, total correct, percent correct, total incorrect, and total invalid for each part and overall totals for each student.

2. Item Analysis (example C) - a count is provided for the total number of students that responded to each of the 5 responses for each item. For example, item 1: 86 answered A, 105 answered B, 92 answered C, 133 answered D, 58 answered E and 7 had invalid or blank responses. The correct response is identified with a plus sign for reference. Every item is represented by two additional line entries:

a.) High - the responses for the top 27% of the students with the highest score for a given part.

b.) Low - the responses for the bottom 27% of the students with the lowest score for a given part.

In addition, the discrimination index is computed for each item to check the reliability.

3. Statistics (example D) - frequency distribution of raw scores showing mean and standard deviation for each part of the test.

Perhaps this General Purpose approach is not a revolutionary one but it did accomplish the results we were looking for - the variety of input sheets is kept to a minimum and the number of programs required is easily justified.

II. SURVEYS & QUESTIONNAIRES

District surveys and questionnaires can be processed three different ways. If the survey or questionnaire is extensive, the General Purpose form can be used. The normal output is the item analysis. If the survey or questionnaire is less than 15 items and the questions must appear on the answer sheet, a standard scanner form (form F1691) is used. A master is made with the questions on the left of the form and the types of responses desired (seldom - always - never, etc.) below the response bubbles. This master is reproduced on the number of survey sheets required.

The latest modification in the Survey area is a weight analysis. A weight factor is given to each response. The factor can be 'forward' (5,4,3,2,1) or 'reverse' (1,2,3,4,5). Normal output can be individual rosters indicating total weight and average weight for each part, item analysis, and frequency distribution. (samples #4, #5, #6)

At this point in time, all of the surveys and questionnaires have been limited to 1 response per item. Two responses in the same item will produce an invalid item. A need has arisen for a multiple response survey questionnaire form. A form now being designed allows up to 15 multiple responses for a maximum of 80 items.

III. GRADE REPORTING (sample #7)

Every teacher in the Phoenix Union High School district has a maximum of 5 classes. Each teacher receives 5 grade reporting scanner sheets (11" x 17"). Each sheet is preprinted with proper header information, and the student name and number of up to 36 students. While the sheets are printed, an output tape is created recording each student and physical position on the sheet. Each sheet is also preslugged with a consecutive decimal reference number. We have tried a binary number but found it unacceptable for 'zero' verification. In the decimal configuration a check can be made for the presence or absence of a digit in each column. In binary format a zero and blank appear the same.

To make certain that the pre-slugging is sharp and readable, the printer over prints three times; a lozenge twice and finally the character 'X'. We find this combination very effective.

When we initially printed pre-slugged sheets, we changed printer ribbons and used a special scanner ribbon. Rather than spend the time changing ribbons we decided to spend $1.00 more per ribbon and use scanner ribbons all of the time.

IV. INTERGOVERNMENTAL AGREEMENTS

After the basic skills program was introduced in the Phoenix Union High School district, the surrounding elementary feeder districts initiated a similar program for various levels for mathematics, reading, and writing. Since school districts in Arizona are unable to purchase services from one another, an intergovernmental agreement was drawn up involving all districts. All 14 districts share the NCS scanner and Honeywell computer. Funds are pooled to cover the cost of the operator, forms, paper labels, etc. The project produces no profit but is being done as a cooperative effort simply to raise the basic skill levels of students in both the elementary and high schools.

Previous attempts at cooperative testing proved to be semi-successful due to the fact the only scanner available was an inexpensive card scanner. The problems that we encountered were: 1.) maximum of 80 items per card; 2.) multiple card sets for larger tests and 3.) accuracy. Needless to say, the page scanner has made life a little easier.

V. SUMMARY

Looking back at our last three years of experience on the optical scanner, we have been extremely satisfied with the results. Our utilization has been concentrated on testing but we are gradually expanding into other areas - employee absence reporting, personnel information, etc. If there is one outstanding advantage of the optical page scanner, it would have to be ACCURACY. The ability to read both sides of the sheet simultaneously and being able to read either 8-1/2" x 11" or 11" x 17" sheets has proved to be beneficial. One benefit we derived from the system that we did not anticipate, is the use of the printer as an additional peripheral device. When our Honeywell printer is busy with one job, a second print job is spooled to magnatic tape. This tape is mounted on the NCS system drive and the job is printed on the scanner system printer.

Since our scanner is used only for one eight hour shift, we sell time on the second shift. Our revenue last year more than paid for our monthly maintenance.

NAME LAST FIRST

SEX FEMALE MALE

BIRTH DATE YR. MO.

IDENTIFICATION NUMBER

GRADE OF EDUCATION

121 A B C D E	131 A B C D E	141 A B C D E	151 A B C D E	161 A B C D E	171 A B C D E
122 A B C D E	132 A B C D E	142 A B C D E	152 A B C D E	162 A B C D E	172 A B C D E
123 A B C D E	133 A B C D E	143 A B C D E	153 A B C D E	163 A B C D E	173 A B C D E
124 A B C D E	134 A B C D E	144 A B C D E	154 A B C D E	164 A B C D E	174 A B C D E
125 A B C D E	135 A B C D E	145 A B C D E	155 A B C D E	165 A B C D E	175 A B C D E
126 A B C D E	136 A B C D E	146 A B C D E	156 A B C D E	166 A B C D E	176 A B C D E
127 A B C D E	137 A B C D E	147 A B C D E	157 A B C D E	167 A B C D E	177 A B C D E
128 A B C D E	138 A B C D E	148 A B C D E	158 A B C D E	168 A B C D E	178 A B C D E
129 A B C D E	139 A B C D E	149 A B C D E	159 A B C D E	169 A B C D E	179 A B C D E
130 A B C D E	140 A B C D E	150 A B C D E	160 A B C D E	170 A B C D E	180 A B C D E

181 A B C D E	191 A B C D E	201 A B C D E	211 A B C D E	221 A B C D E	231 A B C D E
182 A B C D E	192 A B C D E	202 A B C D E	212 A B C D E	222 A B C D E	232 A B C D E
183 A B C D E	193 A B C D E	203 A B C D E	213 A B C D E	223 A B C D E	233 A B C D E
184 A B C D E	194 A B C D E	204 A B C D E	214 A B C D E	224 A B C D E	234 A B C D E
185 A B C D E	195 A B C D E	205 A B C D E	215 A B C D E	225 A B C D E	235 A B C D E
186 A B C D E	196 A B C D E	206 A B C D E	216 A B C D E	226 A B C D E	236 A B C D E
187 A B C D E	197 A B C D E	207 A B C D E	217 A B C D E	227 A B C D E	237 A B C D E
188 A B C D E	198 A B C D E	208 A B C D E	218 A B C D E	228 A B C D E	238 A B C D E
189 A B C D E	199 A B C D E	209 A B C D E	219 A B C D E	229 A B C D E	239 A B C D E
190 A B C D E	200 A B C D E	210 A B C D E	220 A B C D E	230 A B C D E	240 A B C D E

NAME

GENERAL PURPOSE - NCS - ANSWER SHEET

FOR PROCESSING BY **NATIONAL COMPUTER SYSTEMS** 4401 West 76th St., Minneapolis, Minn.

IMPORTANT DIRECTIONS FOR MARKING ANSWERS

Use black lead pencil only (#2½ or softer.
Make heavy black marks that fill the circle completely.
Erase clearly any answer you wish to change.
Make no stray marks on this answer sheet.

← REFER TO THESE EXAMPLES BEFORE STARTING PRACTICE EXERCISES →

1 A B C D E	11 A B C D E	21 A B C D E	31 A B C D E	41 A B C D E	51 A B C D E
2 A B C D E	12 A B C D E	22 A B C D E	32 A B C D E	42 A B C D E	52 A B C D E
3 A B C D E	13 A B C D E	23 A B C D E	33 A B C D E	43 A B C D E	53 A B C D E
4 A B C D E	14 A B C D E	24 A B C D E	34 A B C D E	44 A B C D E	54 A B C D E
5 A B C D E	15 A B C D E	25 A B C D E	35 A B C D E	45 A B C D E	55 A B C D E
6 A B C D E	16 A B C D E	26 A B C D E	36 A B C D E	46 A B C D E	56 A B C D E
7 A B C D E	17 A B C D E	27 A B C D E	37 A B C D E	47 A B C D E	57 A B C D E
8 A B C D E	18 A B C D E	28 A B C D E	38 A B C D E	48 A B C D E	58 A B C D E
9 A B C D E	19 A B C D E	29 A B C D E	39 A B C D E	49 A B C D E	59 A B C D E
10 A B C D E	20 A B C D E	30 A B C D E	40 A B C D E	50 A B C D E	60 A B C D E

61 A B C D E	71 A B C D E	81 A B C D E	91 A B C D E	101 A B C D E	111 A B C D E
62 A B C D E	72 A B C D E	82 A B C D E	92 A B C D E	102 A B C D E	112 A B C D E
63 A B C D E	73 A B C D E	83 A B C D E	93 A B C D E	103 A B C D E	113 A B C D E
64 A B C D E	74 A B C D E	84 A B C D E	94 A B C D E	104 A B C D E	114 A B C D E
65 A B C D E	75 A B C D E	85 A B C D E	95 A B C D E	105 A B C D E	115 A B C D E
66 A B C D E	76 A B C D E	86 A B C D E	96 A B C D E	106 A B C D E	116 A B C D E
67 A B C D E	77 A B C D E	87 A B C D E	97 A B C D E	107 A B C D E	117 A B C D E
68 A B C D E	78 A B C D E	88 A B C D E	98 A B C D E	108 A B C D E	118 A B C D E
69 A B C D E	79 A B C D E	89 A B C D E	99 A B C D E	109 A B C D E	119 A B C D E
70 A B C D E	80 A B C D E	90 A B C D E	100 A B C D E	110 A B C D E	120 A B C D E

NCS Trans-Optic P0998-10 98

ANSWER INDICATED BY (*) ROSTERS

SCHOOL CENTRAL TEA. SOPHS PERIOD SUBJECT LANG.CONCEPTS INVT. TEST 003

ONLY INCORRECT RESPONSES SHOWN BLANK OR INV

KEY PAGE

CORRECT ANSWERS			1A	2B	3A	4A	5A	6B	7B	8B	9A	10B	11A	12A	13B	14B	15A	16A	17A
*****PART 1 24A	25B	26B	27B	28B	29B	30A	31B	32A	33B	34B	35A	36A	37A	38A	39A	40B	41B	42B	43B
CORRECT ANSWERS			1A	2B	3A	4A	5A	6B	7B	8B	9A	10B	11A	12A	13B	14B	15A	16A	17A
*****PART 2 24A	25B	26B	27B	28B	29B	30A	31B	32A	33B	34B	35A	36A	37A	38A	39A	40B	41B	42B	43B

EXAMPLE

A KEY PAGE IS PRINTED FOR EACH GROUP OF ROSTERS

BLANK OR INVALID ANSWER INDICATED BY (*) EXAMPLE B RDSTERS TEST 003
HOOL CENTRAL ... .. TEA. SCHS . . PERIOD SUBJECT LANG.CONCEPTS INVT.
ONLY INCORRECT RESPONSES SHOWN

***PART 2 1B 5B 9B 10A 11B 14A 15B 21A 23A 25* 26A 27A 31A 3
RIGHT 26 WRNG 18 INVD 1 % 57.8 (STUDENT NAME APPEARS
ON RIGHT SIDE OF REPORT)
T. RIGHT 52 WRNG 36 INVD 2 % 57.8

***0086
***PART 1 3B 5B 9B 10A 11B 13A 14A 15B 18B 20A 24* 25* 26A 2
43A 44A 45B
RIGHT 19 WRNG 23 INVD 3 % 42.2
***PART 2 3B 5B 9B 10A 11B 13A 14A 15B 18B 20A 24* 25* 26A 2
43A 44A 45B
RIGHT 19 WRNG 23 INVD 3 % 42.2

T. RIGHT 38 WRNG 46 INVD 6 % 42.2

***0087
***PART 1 5B 8* 9* 10* 11B 13A 14A 21A 23A 25* 27A 37* 38B 3
RIGHT 28 WRNG 9 INVD 8 % 62.2
***PART 2 5B 8* 9* 10* 11B 13A 14A 21A 23A 25* 27A 37* 38B 3
RIGHT 28 WRNG 9 INVD 8 % 62.2

T. RIGHT 56 WRNG 18 INVD 16 % 62.2

***0088
***PART 1 1B 2A 4* 5* 6* 7* 8A 9B 10* 11B 13* 14A 15B 1
2 29* 30* 31* 34A 36* 38* 40A 41* 42* 43A 44A 45*
RIGHT 9 WRNG 14 INVD 22 % 20.0
***PART 2 1B 2A 4* 5* 6* 7* 8A 9B 10* 11B 13* 14A 15B 1
28* 29* 30* 31* 34A 36* 38* 40A 41* 42* 43A 44A 45*
RIGHT 9 WRNG 14 INVD 22 % 20.0

T. RIGHT 18 WRNG 28 INVD 44 % 20.0

***0089
***PART 1 2A 5B 9B 10A 11B 13A 14A 15B 16B 18* 19A 20A 22B 2
43A 44A
RIGHT 20 WRNG 23 INVD 2 % 44.4
***PART 2 2A 5B 9B 10A 11B 13A 14A 15B 16B 18* 19A 20A 22B 2
43A 44A
RIGHT 20 WRNG 23 INVD 2 % 44.4

T. RIGHT 40 WRNG 46 INVD 4 % 44.4

***0090
***PART 1 2A 6A 7A 8A 10A 13A 19A 20A 21A 23A 25A 26A 28A 2
RIGHT 27 WRNG 18 INVD % 60.0
***PART 2 2A 6A 7A 8A 10A 13A 19A 20A 21A 23A 25A 26A 28A 2
RIGHT 27 WRNG 18 INVD % 60.0

T. RIGHT 54 WRNG 36 INVD % 60.0

CLASS AVERAGE % 59.3

CHOOL CENTRAL TEA. SENIORS ITEM ANALYSIS PERIOD SUBJECT LANG.CONCEPTS INVT.
TEST# 001 PART# 2 RIGHT ANSWER INDICATED BY (+)

QUESTION NUMBER	DSCR. INDEX		RESPONSE A	RESPONSE B	RESPONSE C	RESPONSE D	RESPONSE E	INVALID OR BLNK
010	********	HIGH	3 60.0	2+ 40.0	.0	.0	.0	
	.00	LOW	3 60.0	2+ 40.0	.0	.0	.0	
		TOTAL	14 70.0	6+ 30.0	.0	.0	.0	
011	********	HIGH	+ .0	5 100.0	.0	.0	.0	
	.40-	LOW	2+ 40.0	3 60.0	.0	.0	.0	
		TOTAL	2+ 10.0	18 90.0	.0	.0	.0	
012	********	HIGH	5+ 100.0	.0	.0	.0	.0	
	.20	LOW	4+ 80.0	1 20.0	.0	.0	.0	
		TOTAL	17+ 85.0	3 15.0	.0	.0	.0	
013	********	HIGH	.0	5+ 100.0	.0	.0	.0	
	.60	LOW	3 60.0	2+ 40.0	.0	.0	.0	
		TOTAL	11 55.0	9+ 45.0	.0	.0	.0	
014	********	HIGH	3 60.0	2+ 40.0	.0	.0	.0	
	.20-	LOW	2 40.0	3+ 60.0	.0	.0	.0	
		TOTAL	14 70.0	6+ 30.0	.0	.0	.0	
015	********	HIGH	2+ 40.0	3 60.0	.0	.0	.0	
	.40-	LOW	4+ 80.0	1 20.0	.0	.0	.0	
		TOTAL	10+ 50.0	10 50.0	.0	.0	.0	
016	********	HIGH	3+ 60.0	2 40.0	.0	.0	.0	
	.00	LOW	3+ 60.0	2 40.0	.0	.0	.0	
		TOTAL	9+ 47.4	10 52.6	.0	.0	.0	1
017	********	HIGH	5+ 100.0	.0	.0	.0	.0	
	.40	LOW	3+ 60.0	2 40.0	.0	.0	.0	
		TOTAL	16+ 84.2	3 15.8	.0	.0	.0	1
0[illegible]	********	HIGH	3+ 60.0	2 40.0	.0	.0	.0	
	.00	LOW	3+ 75.0	1 25.0	.0	.0	.0	1
		TOTAL	15+ [illegible]	4 [illegible]	[illegible]	[illegible]	[illegible]	1

EXAMPLE D

Sub-parts . Breakdown

STATISTICAL RECAP REPORT 72-73

SCHOOL 14 001

NON CUMULATIVE BY SCHOOL

GENL. PURPOSE

RAW SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	PART 6	PART 7	PART 8	PART 9
0		24		1	7	10	23	4	4
1		35		3	9	9	1		
2	1	63	9	29	10	22	2	5	1
3			16	44	26	34	1	11	
4	2		13	41	27	24	1	18	2
5	4		9	4	9	18	1	23	
6	10		22		17	5	3	37	
7	12		15		9		1	24	2
8	15		12		8				4
9	15		15				5		12
10	27		7				3		14
11	20		4				3		9
12	7						3		21
13	9						9		21
14							7		11
15							59		21

-21-

PAGE 2

STATISTICAL RECAP REPORT

SCHOOL 14 001.

NON CUMULATIVE BY SCHOOL

GENL. PURPOSE

RAW SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	PART 6	PART 7	PART 8	P
TOTAL STDNT.	122	122	122	122	122	122	122	122	1.
SCORE SUMS	1120	161	745	377	489	371	1286	620	1
MEAN	9.1	1.3	6.1	3.0	4.0	3.0	10.5	5.0	
SCORE2 SUMS	10908	287	5307	1271	2505	1417	17284	3499	17
S.D. SQUARED	5.13	.61	6.21	.87	4.47	2.37	35.48	2.78	10
STAND. DEV.	2.264	.781	2.491	.932	2.114	1.539	5.955	1.667	3.

31

28

EXAMPLE # 4

```
22122
***** PART   1         6-5   19-5   33-5   43-5
      WEIGHT  20             AVRG.  5.000         INVD
***** PART   2        10-5   15-5   25-5   39-5   45-5
      WEIGHT  24             AVRG.  4.200         INVD
***** PART   3         8-5    9-5   13-5   14-3   20-5   26-5   31-5   37-5
      WEIGHT  38             AVRG.  4.750         INVD
***** PART   4         7-5   22-5   29-4   38-5   42-5
      WEIGHT  20             AVRG.  4.000         INVD
***** PART   5        12-5   17-5   2?-5   35-5   41-5   44-5
      WEIGHT  30             AVRG.  5.000         INVD
***** PART   6        11-*   23-5   27-5   30-5   36-5
      WEIGHT  20             AVRG.  4.000         INVD
***** PART   7        15-5   18-5   21-5   27-5   32-5   34-5   40-5
      WEIGHT  35             AVRG.  5.000         INVD
***** PART   8         6-1    7-1    8-1    9-1   10-1   11-4   12-1   13-1   14-3   15-1   16-2   17-1   18-1   19-1   20-1   21-1   22-1   23-1   24-1
  25-1   26-1   27-1   28-1   29-1   31-1   31-1   32-1   33-1   34-1   35-1   36-1   37-1   38-1   39-1   40-1   41-1   42-1   43-1   44-1   45-1   46-5
  47-5   48-5   49-5   50-5   51-5   52-5   53-4   54-5   55-4   56-5   57-5   58-5   59-3   60-3   61-4   62-4   63-3   64-4   65-3   66-5
      WEIGHT 131             AVRG.  2.148         INVD

TOTAL WEIGHT 318

12111
***** PART   1         6-5   19-5   33-5   43-5
      WEIGHT  20             AVRG.  5.000         INVD
***** PART   2        10-5   16-1   25-5   39-5   45-5
      WEIGHT  21             AVRG.  4.200         INVD
***** PART   3         8-5    9-5   13-5   14-5   20-5   26-5   31-5   37-5
      WEIGHT  40             AVRG.  5.000         INVD
***** PART   4         7-5   22-4   29-*   35-5   42-5
      WEIGHT  19             AVRG.  3.800         INVD
***** PART   5        12-5   17-2   2?-5   35-5   41-5   44-5
      WEIGHT  27             AVRG.  4.500         INVD
***** PART   6        11-5   23-4   28-5   30-5   36-5
      WEIGHT  24             AVRG.  4.800         INVD
***** PART   7        15-5   18-5   21-5   27-5   32-5   34-5   40-5
      WEIGHT  35             AVRG.  5.000         INVD
***** PART   8         6-1    7-1    8-1    9-1   10-1   11-1   12-1   13-1   14-1   15-1   16-5   17-4   18-1   19-1   20-1   21-1   22-2   23-2   24-1
  25-1   26-1   27-1   28-1   27-1   3?-1   31-1   32-1   33-1   34-1   35-1   36-1   37-1   38-1   39-1   40-1   41-1   42-1   43-1   44-1   45-1   46-5
  47-5   48-5   49-5   50-5   51-5   52-5   53-1   54-2   55-3   56-4   57-5   58-4   59-4   60-2   61-2   62-3   63-3   64-4   65-2   66-5
      WEIGHT 127             AVRG.  2.002         INVD

TOTAL WEIGHT 313

31132
***** PART   1         6-5   19-3   33-3   [illegible]3-5
      WEIGHT  16             AVRG.  4.000         INVD
***** PART   2        10-4   16-4   25-5   39-3   45-4
      WEIGHT  20             AVRG.  4.000         INVD
***** PART   3         8-5    9-5   13-5   14-5   20-5   26-5   31-2   37-3
      WEIGHT  35             AVRG.  4.375         INVD
***** PART   4         7-5   22-5   29-3   30-3   42-5
      WEIGHT  21             AVRG.  4.200         INVD
***** PART   5        12-4   17-4   24-4   35-3   41-4   44-3
      WEIGHT  22             AVRG.  3.667         INVD
***** PART            11-5   23-5   29-4   30-3   36-2
```

ITEM ANALYSIS--WEIGHTED SCORES (SAMPLE #5)

SCHOOL-ANDERSON QUEST, TEA, COMBINED TEACH, PERIOD SUBJECT

TEST# 001 PART# 1

QUESTION NUMBER			-WEIGHT- 5	-WEIGHT- 4	-WEIGHT- 3	-WEIGHT- 2	-WEIGHT- 1	INVALID OR BLANK	AVERAGE
006 ********		HIGH	14 / 73.7	5 / 26.3	.0	.0	.0		4.736
	.00	LOW	2 / 10.5	3 / 15.8	7 / 36.8	4 / 21.1	3 / 15.8		2.642
	REVERSE	TOTAL	21 / 29.6	29 / 40.8	14 / 19.7	4 / 5.6	3 / 4.2		3.859
019 ********		HIGH	6 / 31.6	8 / 42.1	5 / 26.3	.0	.0		4.052
	.05-	LOW	1 / 5.6	1 / 5.6	7 / 38.9	6 / 33.3	3 / 16.7	1	2.500
	REVERSE	TOTAL	7 / 10.1	25 / 36.2	23 / 33.3	9 / 13.0	5 / 7.2	2	3.289
033 ********		HIGH	10 / 52.6	7 / 36.8	2 / 10.5	.0	.0		4.421
	.00	LOW	.0	3 / 15.8	6 / 31.6	4 / 21.1	6 / 31.6		2.315
	REVERSE	TOTAL	15 / 21.1	25 / 35.2	18 / 25.4	7 / 9.9	6 / 8.5		3.507
043 ********		HIGH	14 / 73.7	5 / 26.3	.0	.0	.0		4.736
	.00	LOW	.0	4 / 21.1	5 / 26.3	5 / 26.3	5 / 26.3		2.421
	REVERSE	TOTAL	19 / 26.8	21 / 29.6	19 / 26.8	6 / 8.5	6 / 8.5		3.577

TOTAL 3.560

(EXAMPLE #6)

STATISTICAL RECAP REPORT

NON CUMULATIVE BY SCHOOL
GENL. PURPOSE

SCHOOL 001 75-76

RAW SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	PART 6	PART 7	PART 8	PART 9	PART 10	PART 11	PART 12
5	1			2								
6	1											
7	2	1			2	2						
8	2	1										
9	1						1					
10	1	3				2						
11	3	1	1	2		2						
12	6	3	1		1	1	1					
13	8	3		4	2	2	2					
14	10	3	2			3	1					
15	10	7		3	1	4	1					
16	10	4		4	1	6						
17	1	4		12	2	5	3					
18	7	9	2	1	3	7	3					
19	2	8		9	8	7						
20	4	7	1	9	10	6	1					
21		5	1	10	2	9	4					
22		8	2	5	4	5	4					
23		2	2	3	5	3	2					
24		1	2	4	8	3	2					
25		1	4	3	5	4	3					
26			3		3		7					
27			4		1		7					
28			2		4		7					
29			8		4		4					
30			3		5		3					
31			6				3					
32			5				3					
33			2				1					
34			6				4					
35			3				4					
36			4									
37			2									
38			2									
40			3					1				
123								1				
126								1				
127								1				
131												

STATISTICAL RECAP REPORT

NON CUMULATIVE BY SCHOOL
GENL. PURPOSE

SCHOOL 001 75-76 3

RAW SCORE	PART 1	PART 2	PART 3	PART 4	PART 5	PART 6	PART 7	PART 8	PART 9	PART 10	PART 11	PART 12
TOTAL STDNT.	71	71	71	71	71	71	71	71				
SCORE SUMS	1004	1240	2065	1326	1568	1296	1813	11677				
MEAN	14.1408	17.4648	29.0845	18.6761	22.0845	18.2535	25.5352	164.4648				
SCORE2 SUMS	14984	22756	63049	25904	36452	24890	48963	1955761				
S.D.SQUARED	11.03	15.49	42.11	16.05	25.68	17.37	37.57	497.26				
STAND. DEV.	3.328	3.935	6.489	4.006	5.067	4.167	6.129	22.299				

[illegible] SYSTEM

[illegible] TIONNAIRE FORM

IMPORTANT DIRECTIONS FOR MARKING SELECTIONS.

- Use black lead pencil only (No. 2½ or softer.)
- Make heavy black marks that fill the circle completely
- Erase clearly any selection you wish to change.
- Make no stray marks on this answer sheet.

←REFER TO THESE EXAMPLES BEFORE MARKING THIS SHEET.

1.	I SEE MY COUNSELOR	VERY OFTEN	OFTEN	SOMETIMES	NOT IN AWHILE	NEVER
2.	THE OBJECTIVES OF MY CLASSES ARE EXPLAINED	VERY CLEARLY	CLEARLY	SOMEWHAT CLEARLY	NOT VERY CLEAR	NEVER EXPLAINED

NCS Trans-Optic F1691 54321

NAME

SEX

FEMALE

MALE

BIRTH DATE

Yr. | Mo.

[redacted]

IDENTIFICATION NUMBER

GRADE OR EDUCATION

PHOENIX UNION HIGH SCHOOL SYSTEM
GRADE REPORTING

SCHOOL — REPORTING PERIOD

TEACHER NO — TEACHER NAME — PERIOD — SUBJECT — COURSE NO

PAGE NUMBER

DO NOT MARK ABOVE THIS LINE — DO NOT MARK ON REVERSE SIDE OF SHEET

INSTRUCTIONS

1 Use a black lead pencil (No. 2½ or softer).
2 Fill circles completely.
3. Make clean erasures.
4. Do not make stray marks.
5. At end of term – mark only: term grade - term days absent – comments.
6. At end of semester - mark: term grade - semester exam grade - semester grade - term days absent - comments.
7 Marking term days absent - if days absent are less than 10, fill appropriate circle 1 through 9 only. If more than 10, mark proper tens (10-20-30) circle plus the proper units circle. For example, if a student is absent 12 days, fill the 10 circle and the 2 circle.

GRADES

1 = Superior
2 = Above Average
3 = Average
4 = Below Average
F = Failure
A = Audit
W = Withdrawal
I = Incomplete
S = Satisfactory
U = Unsatisfactory

If no grade is to be given, fill circle marked "NO GRADE – DROP"

COMMENTS — SELECT A MAXIMUM OF FOUR ONLY

0. Absences are affecting school work.
1. Excessive tardies are affecting school work
2. Books or materials are not brought to class.
3. Assignments are not completed satisfactorily
4 Failure to make up work has affected grade.
5. Student could make better use of his time.
6. Student shows definite improvement.
7 Student contributes to the class.
8. Student makes an outstanding effort.
9. Student is enthusiastic about learning.

HUMANIZING THE COMPUTER

Donald J. Russeau

Glenbrook High School Dist. 225, Glenview-Northbrook, Illinois 60025

ABSTRACT: A discussion of the concept of placing total responsibility of inputting data in the user's hands. The new role of the user will be discussed, in addition to how the computer is humanized. The major emphasis of the discussion will be placed on the implementation and use of an on-line, real-time student accounting data base with concomitant updating.

Introduction

Why have a computer system in a school setting? Does the computer enhance the school's overall operation? What areas should the computer attempt to enhance? How should the computer be organized in a school setting? Who should organize and administer a computer system in a school environment? And, finally, how can a computer be "humanized"?

The purpose of this paper is to discuss the ramifications of a computer system in a school environment. We shall examine the philosophy that must support it, the administration that must organize and coordinate it, the dollars that are necessary to sustain it, and the people that are needed to "humanize" it.

After some experience with card systems, the Glenbrook school system entered the computer age with less than desirable results. It was decided that the computer must better respond to the school district's needs. These needs, along with a philosophy, were developed in early spring of 1974. After the needs and philosophy were developed, the software, hardware and a director of computer services were selected. Computer services began a new existance on July 1, 1974.

Glenbrook School District No. 225 is located in the north shore area of Chicago, close to O'Hare Airport. It is composed of two high schools: Glenbrook North High School with 2,800 students, and Glenbrook South High School with 2,500 students. The computer site is in the District offices located at Glenbrook South High School.

There are about 340 teachers in both schools. Each school has an administrator in charge of scheduling, a coordinator to computer services, and a scheduling secretary. There are two attendance secretaries, a registrar and assistant registar. In the business office, there is a director of business affairs; an accountant who works with computer services by coordinating data; two accounts payable clerks; two accounts receivable clerks; and a payroll clerk. All of these people are involved with the computer services operation as part of a team.

How We Selected Our Computer System

Before one looks at the actual system, the needs and the philosophy which support the total operation should be reviewed. The new computer system as a whole would have to alleviate some serious problems experienced in the past. Some of these problems were inaccurate data, time perimeters not being met for hardbound reports, and a general lack of confidence in the whole processing system.

With these problems in mind, the following criteria were used to select a new computer system for Glenbrook School District No. 225.

(1) The software must support all of the processing needs, including on-line and batch systems.

(2) The system should be an on-line, real-time system using video terminals.

(3) The data must be easily processed within a designated department by specified users.

(4) The data bases available should be: student, business, payroll, personnel and inventory.

(5) The cost of this system should be commensurate to the needs of the school district.

The highest priority need was to have appropriate software to support our system. The software must be written specifically for a school operation, be amenable to change and support an on-line, real-time video terminal system.

Having an on-line video terminal system was deemed necessary to provide controls to assure having accurate data. In addition, video terminals would give an opportunity to put data, entry and maintenance where it should be -- with the specific user.

The terminal entry and maintenance should be an easy process for the user. The screens should be properly edited to be certain all of the data elements are appropriate for each specific school application. The terminals must have concurrent entry on-line capabilities so that up to ten users can enter data with a one-to-two-second response.

The student data base is considered the most important. The students are the pinnacle of the school and have many records that must be maintained. The student records, in areas such as attendance and scheduling, create a daily demand system. They are changing on a daily basis and, therefore, need daily updating with commensurate hardbound output.

The business data base must satisfy the sound practices of good business operations. Accurate data can best be assured by having users in that department input their own data using video terminals. Hardbound output data should contain all general, needed business reports in addition to other outputs conducive to the particular system.

The payroll data base must be highly secured, have direct on-line capabilities for error-free data, and have commensurate editing and final payroll output. This particular data base must also comply with business and state-regulated procedures and must produce a printed audit trail.

The personnel data base must be broad in content to handle the many data items associated with the school employees. It must have a capability of updating, having an audit trail and producing many standard and exceptional reports.

The inventory base must have the capability of handling the various data items associated with stock materials of the school. The system should be on-line with hardbound outputs that can be sorted by the various elementary records of the file. The file should also be conducive for use in conjunction with insurance reports.

The cost of the total system, including personnel, should be directly proportionate to the needs. The initial software should be expected to consume a large share of the cost because this is a high priority item. Since on-line software is highly sophisticated, total maintenance cost should be evaluated. Card punching is virtually non-existent with an on-line system, so less personnel is needed. No additional personnel is needed to operate the video terminals as they can be furnished from the existing staff in the user department.

It should be noticeable that hardware was not mentioned in the initial needs. Hardware is, of course, needed and expected but is not viewed in the same light as the other needs. The only factor regarding hardware is having the capability to handle the software, the video terminals, the disk storage with enough CPU capability for adequate internal processing. Though the particular brand of the hardware is insignificant, there should be a proven tract record of reliability and maintenance.

Abounding with these needs and the philosophy, the computer software and hardware were selected. The bits and pieces of computer services were put together for the initial run beginning July 1, 1974.

Our Philosophy

As we look at the needs in computer services, we also have to look at the most important aspect -- that being the computer services philosophy. What is the philosophy of computer services? How does that philosophy fit into the school philosophy?

It is always interesting to note that philosophy, in many cases and in many areas, is forgotten. Either people do not set down what their philosophy is, do not think about their philosophy, or just do not bother to do anything about it. Nonetheless, philosophy is the foundation of any type of organization. Therefore, it should be indicated very precisely and clearly. Everything should be based upon it. So, we set forth our philosophy as follows:

(1) The primary goal is to serve the needs of the school district.
(2) The computer should be able to handle five primary areas of the school operation: (a) student data; (b) business data; (c) payroll data; (d) personnel data; (e) inventory data.
(3) The computer service decisions should be based upon a need-cost basis.
(4) The processing of data should be based upon the need, resources and the ability to produce accurate results.
(5) The system should be supervised by a certified school administrator with commensurate experience in the understanding of school procedure and computer processing.
(6) All data should be the responsibility of the users in designated departments of the school system for creating, deleting or updating records.

The primary goal is to serve the needs of the school district. The computer is a subsidiary to the educational process of the school. It should not get in the way; it should just assist the educational process. The computer should and must be able to handle the five primary areas in school operation -- student, business, payroll, personnel and inventory data. These are in priority order. The students obviously are first; that's what school is all about. Students are the product that forms the existence of a school system.

The computer services decision should be based on a need-cost basis. If there is a need, and if the need is worthwhile, it should measure up to "X" amount of dollars. By following this philosophy, we can analyze our needs before we move ahead.

A screening process should occur. It is very easy for a computer system to be using or expending more money on equipment than is needed, or processing various jobs that do not fit any particular priority order. For example, for us to expend a great deal of money on inventory would be wrong. The student, business, payroll, data bases should have a much higher priority. To use a computer only as a typewriter or an adding machine is wrong. A computer should be used for those types of operations and appropriate processing that are conducive to the sophistication of its machinery.

The processing of data should be based upon need, the resources, and the ability to produce accurate results. How many times do we see computer services say they can do something but then cannot produce? How many times do we see computer services doing work that is not based upon need but upon the whims of someone in the organization? How many times do we see a large amount of money being expended for computer hardware and a very small amount expended for the software? What good is hardware without good software? It is software that makes the operation go, not just the hardware. The hardware merely supports the software.

The system should be supervised by a certified school administrator with commensurate experience and an understanding of the school. We will talk about this later in our paper. However, it is the philosophy of our school district that the person in charge of the computer service organization should have experience in school administration and a thorough understanding of how schools operate with a particular depth of understanding in the student personnel area.

All data should be the responsibility of the users in the designated departments of the school system for creating, deleting or updating records. The philosophy here is very simple -- it is the users who should be responsible for their data. The user who is knowledgeable and understands the particular data is the one who should be handling all the data. The computer is used only to process that data in whatever fashion is deemed necessary.

Herein is the philosophy of School District No. 225 concerning computer services. This is the foundation the total organization is based upon and the foundation from which it operates.

The School as a City

Earlier in our discussion of philosophy, it was indicated that a certified school administrator should be involved and should be the director of computer service. We also talked about the complexities of the school. Let us look at schools in more depth.

The operation of a school can be compared to that of a small city. There is a public called students who are the recipients of learning. Teachers maintain the learning process. Administrators, teachers, clerical and custodial help perform their appropriate roles within the school just as workers in a city. And, as in a city, records of all kinds must be maintained. The Board of Education is the equivalent of a city council. The school even has a "mayor" called a principal. It is a complete business operation. There are many dollars involved in the operation of this special "city".

School is a big business. In many communities, it is the biggest business in town. Thousands of dollars are spent in schools throughout the country. It is a business, it should be operated like a business. It requires many different types of accounting systems including those in student and business records.

Looking at this "city" in depth indicates that its major function is to be a place of learning. Every function of the school is a subsidiary to the students. The students are what school is about. Everything else should support student learning. Computer services, like any other services, should be organized to support the students. Students are in the school to learn.

Learning is a very complicated process. It is a process in which educators are continually trying to improve their understanding and skills. When one looks at the complexities of learning, it is apparent that a school, like a city, is occupied by many humans of varied backgrounds -- students, teachers, administrators, school board -- all having different viewpoints about how that city should be run. It is very complex because human beings are very complex. To understand how a school operates takes many years of working within a school. This is one reason that an experienced school administrator in charge of computer services is needed to direct the operation.

The computer is complex in its own right, but in reality it is two things -- very dumb and very fast. It rarely makes mistakes alone. Most mistakes are people errors. Though the computer is very sophisticated and requires considerable skill, the highest degree of human skills is needed for understanding and working with people.

If we look at the computer in this light, we can see that the advantages to having a person in charge who understands both the school operation and the computer operation can put the computer and the school together in its proper perspective. The computer is a service to the school. It should be used to assist the school operation in every way possible. The better one understands the school operation, the better the computer services can assist.

Our Administrative Organization

We are organized in such a way that the director of computer services is directly responsible to the superintendent. The position is commensurate with the director of personnel, business, special education, and curriculum. This organizational arrangement is not only good financially, but also puts the computer in its proper light in terms of having the computer services on an equal basis with all the other services of the school.

Since monies are expended in terms of machinery, operation and programming, a need arises for these to be taken to the Board of Education who must authorize all allocations of money. The director of computer services has a direct route through the superintendent who will recommend to the Board of Education the appropriate items. Having this type of organization does enhance the position of computer services.

Having a school administrator in charge of computer services tends to make the job one of respected authority. It is administrative structure with a person who is a certified administrator that creates a positive outlook from all the publics involved in the school. A positive response and cooperation make it much easier for the director of computer services to work as a team member with the publics of the school organization.

Our Computer Software

In looking for software, a language was needed that would be consistent, easy to maintain, easy to work with, and, of course, would have terminal on-line capabilities. After much searching in this area, we finally decided to use a complete software package from:

MIDWEST SYSTEMS GROUP, INC.
5401 Benton
Downers Grove, Illinois 60515

We lease the software package for our system through this company. The programs are written completely in COBOL and include all batch jobs and a complete on-line, real-time system. All input is via terminals; all JCL's reside on disk. Cards are not used in the system. All job control responses are entered via the terminal at the main computer site. The disk, the terminals, and the on-line, real-time system are completely compatible with each other.

The name of the software system is C-A-S-T-S (Computerized-Accounting-System-Terminal-System). It is an on-line, real-time system. All data entry is via video terminals. All data is entered into the system from the department of the user. The user has complete responsiblity for inputting and maintaining their data. This is all supported by the software program. The C-A-S-T-S system allows concurrent operations, via the video terminals, from any department using any data screen in that department (i.e., payroll, updating, student progress, etc.). There are over thirty online video terminal screens. There are also over 100 batch screens used in batch processing jobs.

The financial data base of the C-A-S-T-S system has many types of screens on the on-line system which are used by accounts payable, accounts receivable, payroll, to maintain the various transaction files. There are many related editing and management printouts to help the user with the video terminal entries. Each day a rollover is completed. Any activity entered into the system that day (checks, purchase orders, change in the master transaction file, etc.) are moved into the master transaction file.

A business operation requires a variety of reports by the computer. All business operations are completely on-line and real-time via the C-A-S-T-S system which affords the user the complete responsibility for the data. Within our system, unique reports for our own particular school district have been added. In addition to the many reports printed -- current transactions, master transactions, vendor and edit listings -- there are management reports for the publics in the school and various school board reports. Through our batch-operating system, a complete editing procedure assures that the data is accurate.

Our Computer Hardware

The computer is a stand-alone Four-Phase 96K configuration used for two high schools in our school district. It uses an on-line, real-time video terminal entry system. The two disks, each with 50 million bytes, is ample storage for the 12,000 student data base, 36,000 business data base, plus data bases for personnel, inventory and payroll. The sort time is adequate for our varied production needs. The computer is in operation sixteen hours a day -- eight hours during the day being used mainly for on-line and eight hours during the evening being used for batch jobs.

Auxiliary equipment includes a 1600 BPI tape drive, 700-180 LPM printer and a 300 LPM card reader. There are nine video terminals located as follows:

Glenbrook South High School	3 Terminals
Glenbrook North High School	3 Terminals
Business Office	2 Terminals
Computer Center	1 Terminal

The central computer site is located at the South High School. The North High School, located several miles away, is connected, via modums and a small interfacing unit directly to the central computer. This provides them with direct on-line access with a one-to-two second response.

Student records are maintained on-line for two years. This enables direct access to student files for the previous year. It includes manipulation of all business data for two fiscal years. Summer and evening school are also a part of the data base, including all of the flexibility of the on-line system and producing all of the many batch student and management reports.

Though the time that the computer is down for repairs is minimal, it is felt by the user during the day when the on-line system is in operation. The terminal operators, knowing that the computer is a machine and is susceptible to failures at times, are prepared and understand.

Various types of backups are used and needed with the on-line system. It is imperative to back up the disk drives daily, and to complete a tape backup before any major type of batch job such as payroll or grade reporting.

The operation is a complete daily demand system. Data output involving student and business files is generated on a daily basis. For example, any student who has had a schedule change is flagged. This student will have a new schedule printed that evening for use the next day. His teachers will receive a new class list for attendance purposes, showing the additions or drops in their class that day. Other changes, such as phone number, name change, or, in the business files a change of vendor, will be reflected when it is printed.

In the business department, any purchase orders, impress checks, revolving fund checks, student activity checks are entered on a daily demand system. Checks are printed that day for distribution the following day.

A video terminal system necessitates many precautions. To enter on a terminal, each user has a security code which includes his social security number and other call numbers. Some terminals, such as payroll, are secured so that they can be utilized only by specific users. The terminals also are secured so that one school cannot enter another school's files. It should be noted that with this type of system, one must have documentation to support not only the batch jobs and backup routines but also the video terminal operations.

When one uses video terminals for data entry, it is very important that proper editing occur with all entries into the terminal. The video terminal programming is highly edited, especially in the business area, so that errors are caught at the time of entry as much as possible rather than after they are entered and seen on the output document.

In summarizing the software and the hardware of our system, we emphasize that the most important aspect is the software. Without good software, it doesn't make any difference what type of computer is utilized.

Our philosophy is that the user is the core of the C-A-S-T-S system. They are completely responsible for their data. They have direct access to the data files whenever the need arises to process live data. Complaints for incorrect data goes directly to the source in the department where the original data input occurred. The computer should rarely be blamed for user errors. Anything updated is visually edited via video terminals and through a hardbound copy that follows, or, as in payroll, is seen on an audit trail. With this type of activity by the user the error rate is very low.

Batch reports reflect the data at the time of printing. It is always live and always ready to be processed. Almost any type of report can be generated using any combination of the current data base. The only thing that is left is our own imagination. The particular language of COBOL is easy to work with since it is used exclusively with the on-line and batch system. We can process whatever is needed with any of the data bases.

Humanizing Our Computer

In the humanization of the computer system, it is the user who handles all the data in a designated department. This implements our philosophy and our policy of using the computer as a tool from which people can extract, update and create data. The user is completely responsible for the data input and for the final data output. The output reflects the users input. Hence, all questions regarding any data for a given department are directed and handled by the appropriate knowledgeable personnel in that department. It could be an administrator in charge, or any clerical people who work for that administror, but all responsibility regarding their data will be directly handled by that department.

For example, people who work with student scheduling are the most appropriate ones to answer any questions about scheduling. Those who work with grades or transcripts are the ones to answer questions, correct any errors, or update any information in that area. Personnel in the business office such as accounts payable clerks should handle any questions about the accounts payable data.

It is teamwork that is established with this system. The users feel they are an integral part of a team with others in the school, with the director of computer services and even with the "computer". The computer director continually works with all the various departments in connection with the terminal entry, helping them with various types of data screens, data and output. The users understand that the computer is a machine and they are a part of that machine. They understand that a machine will break down on occasion and that they must maintain their work copy and hardcopy documents for reference in case of a computer data loss. The individual video terminal users need continued assistance with their operation of the terminals. They take pride in the operation of their video terminals and see them as their tool of handling data information in their particular department.

By having the users completely responsible for data input, by creating an atmosphere of teamwork whereby the users work with the director of computer services, and by teaming with the computer, a situation is created where a group of people are actively involved as a team with computer services.

Types of Jobs We Do

As was indicated earlier in our paper, over thirty screens are used for the on-line, real-time system known as C-A-S-T-S (Computerized Accounting Student Terminal System). We also run over 100 batch programs and have many maintenance types of programs to backup, reorganize and massage data for processing. Some of the batch jobs are all types of student reports, sorted in just about any way. There are exceptional types of reports, such as disadvantaged-handicapped reports, special education reports, reason-for-dropping-from-school reports, and various state reports. Master data base reports indicate the number of seats available in a course, how many are taken, and any other information related to a specific course section.

In the attendance data base, on-line attendance screens are used for all data entry. State ADA reporting is also a computerized product of the system. All data for half and whole days is entered via the terminals and edited by the users. Printouts indicating absentee data is printed to be used as a verification/worksheet for attendance personnel.

An extensive on-line grade-reporting system is used. The teachers are given an accurate class list on a special form where the grades are indicated. These grades are then entered via the terminal. The grades are processed through the computer, edited and sent back to the terminal user for minor corrections. A verification sheet is then given to the teacher and the grades are verified. Grade reports are printed, GPA's updated, and class rank transcript labels and various exceptional reports are printed (i.e., honor roll, list of students who received F's, grade distribution, etc.). Grade reports are printed on multi-part paper for distribution to users in addition to using a self-mailer for sending the reports home to parents.

An on-line satisfactory notice report is used. The teacher receives a printed class list on a special form for indicating anybody who is doing unsatisfactory work. This information is then entered via the terminal. An unsatisfactory notice report is printed using a self-mailer with copies going to the teacher and the counselor. It is done on a weekly basis and is completely on-line via the terminals. A new schedule is printed for the student, and a new class list is printed for the teacher on a daily basis.

How We Schedule Our Students

In our student scheduling system, we again utilize the C-A-S-T-S system with on-line, video terminals. All data for students who are going to be scheduled is maintained on the on-line system, before student scheduling occurs and after it is completed.

We load our initial student course-selections using cards. The data from the cards is loaded into the system and maintained via the terminals throughout the entire scheduling process. All of the master schedule is maintained on terminals. Master schedule lists, course tally lists, counseling matrix, course identification lists, student identification lists, counselor-student verification/worksheets and a student course-verification form (sent home to parents via self-mailers) are all outputs of the on-line system. The course verification forms indicate to parents exactly which courses the students are taking.

Special video screens were created to match the input data for the scheduler program. Student data is loaded on tapes to be utilized in the actual scheduling process done outside of our computer complex. After the scheduling is completed, the updated information is loaded back onto our system using the tapes. The student data base is then maintained completely via the video terminals with the user doing the inputting.

Various management reports are then produced including the master schedule, teacher load, course load, room utilization, teacher utilization, master module report and any other reports needed to maintain an adequate scheduling system. Before school opens, auxilliary reports are processed -- class lists, attendance lists, and student schedules.

The master schedules are built by the scheduling administrator in each high school. The scheduling administrator has access to a great deal of updated information which can be processed, such as the matrix, tally, master schedule, enrollment data and the on-line system.

The scheduling on-line screens used on the terminal are specially designed to enter the many types of information that relates to the scheduler. Any type of exceptions utilized by the scheduler can be entered via the terminal so that these can be used at each school's particular discretion for complete individual student exceptions.

Summary

In summary, we have discussed one way of approaching the initiation and operation of a computer service in a high school setting. The emphasis was shown to be based on need and a strong philosophical base from which to build. The organization of the computer service is based upon the premise that a school is a complex place and requires an experienced educator to act as a conduit to the actual computer service.

The main thrust of a computer installation should be in the software which drives the multitudes of data bases. It was particularly apparent that an on-line, real-time video terminal system was the core of the computer operation.

The system is "humanized" by having the users, the computer director and the computer all working as a team to process data for the school system. It is the "humanization" of a computer system that makes it a service for the people of a school, and, after all, schools are all about people.

THE IMPLEMENTATION OF AN INTERACTIVE VERSION OF THE NCHEMS RESOURCE REQUIREMENTS PREDICTION MODEL ON AN APL MICRO-COMPUTER

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Abstract: The Resource Requirements Prediction Model (RRPM) is an instructional cost simulation for post-secondary institutions which has received wide attention as an instructional program information, management and planning tool. Version 1.6 of RRPM is written entirely in ANS COBOL and is designed for batch use on computer systems.

This paper described an interactive version of RRPM, called RRPM/NOW, which runs on a personal sized APL computer. The background of RRPM/NOW and mode of operation are described in detail with examples of operation provided wherever necessary.

RRPM/NOW Background

RRPM 1.6 was designed by NCHEMS (National Center for Higher Education Management Systems) at WICHE (Western Interstate Commission for Higher Education) to be run in batch computer mode. MSU Professor Richard Featherstone, while teaching RRPM as a management aid, found that its concepts could be taught using simplified examples and hand calculations. However, when it was desired to extend the concepts to "real life" examples, the calculations became too burdensome, and therefore, the "real life" examples could not be considered as explicitly as desired.

Dr. Richard Brandt of MSU had the insight to recognize that an interactive version of RRPM would give Featherstone substantial support in his teachings of RRPM concepts. Thus, the development of RRPM/ONLINE was initially motivated by its usefulness as an instructional support tool. Dr. Brandt's version used APL (A Programming Language) via dial-up computer terminals to a remote computer as the means of providing interactive computer access.

Recent technological breakthroughs have enabled micro-computers and other personal sized computers to become powerful alternatives to the traditional large scale time-sharing systems. While they may lack the absolute computing power of the larger systems, they do have the advantage of simplicity. This is largely because the personal sized computers are dedicated to a single user and are operated directly by the user, whereas time-sharing systems serve many users--none of whom actually operate the equipment themselves. Consequently, time-sharing systems must have procedures for protecting users from themselves and other users. This gives rise to the need for sign-on codes, passwords, job cost parameters, time limits, job cost accounting systems and so forth. Additionally, time-sharing systems must have procedures allowing them to be directed from remote locations. Compare the knowledge required for a personal computer user to insert his cassette tape on his machine to a time-sharing user who must give a remote computer operator instructions to load a particular tape.

Because personal sized computers are now available, powerful, and offer greater simplicity to the user, the authors have continued the development of Dr. Brandt's original RRPM/ONLINE model on such an APL personal sized computer. The new version is called RRPM/NOW to highlight the greater simplicity of implementing and using RRPM on personal computers over either interactive or batch time-sharing systems. Now there is no need for telephone communications, for authorization to use the system, for specific system-related knowledge, for specific remote storage and retrieval provisions, and for the concern of the cost of operating the system. The user of RRPM/NOW merely inserts the proper cassette tape and presses the "Start" button.

Objectives

The first objective of RRPM/NOW was to emulate the operations of RRPM Version 1.6 as described in Technical Bulletin 34A[1] published by NCHEMS. In addition to this objective, it was designed with some further objectives in mind. First, any program which is to be used in instruction must be able to store and retrieve several models or examples easily. RRPM/NOW does this through the use of separate tapes for each example. This allows any number of examples, or iterations of examples, to be stored and available for comparative purposes.

In addition to ready storage and retrieval of examples, another secondary objective for

RRPM/NOW was the provision for the entry of "what if" questions to determine the projected impact of various actions. To do this, any input can be respecified simply by reuse of its original input program, e.g., run IN3 (Input Program 3) by itself. Alternately, a user with knowledge of the APL language can manipulate the variables any way he chooses. For example, the enrollment can be increased by a blanket 10 percent by entering ENRL ← 1.1 x ENRL, where ENRL is the name of the variable holding enrollment data. Thus, it is possible for an individual to enter an example and then to change it easily in response to "what if" questions. The original model will remain unchanged for later comparisons, and the new model can be saved or discarded at the option of the user.

In addition to the objectives of emulating RRPM 1.6 and modifying it for more effective use as an instructional tool, RRPM/NOW was designed as a tool for experimentation with certain modifications to the RRPM concept. This system was designed in small modules to allow for the future construction of different types of models. For example, a historical study could be made by using both student enrollment and faculty FTE's to determine productivity and costs. A second example would be to input a given faculty and simulate the type of enrollment the institution could then handle. A third example may be to input a salary budget and a salary schedule and simulate the number of faculty possible at varying levels and the consequent possible enrollment. Thus, RRPM/NOW could be used to produce outputs which would become the inputs to a system of linear equations. This system would then be used to find the "ideal" balance between faculty and enrollment, given certain restraints.

Input

RRPM/NOW input consists of a series of input programs which take advantage of the dynamic nature of APL to set and adjust data variable dimensions by using other variables. Consequently, the first input programs are used to gather literal data regarding the names of the user's disciplines, course levels, student programs, and so forth. In each case, the number of names correspond to the size of the variables which will hold the associated numeric data.

The dynamic nature of APL variables provides for efficient computer memory. Within reasonable limits, the size of individual variables is relatively unimportant. For example, there are no fixed sizes (e.g., 8 characters) for faculty rank names, discipline names, or any other literal data. The dynamic nature of APL variables allow them to be the exact size the user needs. The output programs which use these literal names automatically compensate for the length of the relevant names. This usually implies that long names shift output to the right, and consequently, one should be careful not to exceed the width capabilities of the printer or paper used for the output.

Illustration 1

INPUT FOR COURSE LEVELS,
STUDENT LEVELS, AND FACULTY RANKS

```
      IN1
TYPE COURSE LEVEL NAMES
□ LD
□ UD
□ GD.
TYPE STUDENT LEVEL NAMES
□ LD
□ UD
□ GD.
TYPE FACULTY RANK NAMES
□ PROF
□ ASSOC
□ ASST
□ INST.
```

(Note: A period terminates each level of input above.)

Illustration 2 shows the entry of the numeric data for student enrollment.

Illustration 2

INPUT OF STUDENT ENROLLMENT
BY PROGRAM AND STUDENT LEVEL

```
      IN7
TYPE 3 ENROLLMENTS LD UD GD
PROGRAM    HISTORY
□
      143 186 52
PROGRAM    BIOLOGY
□
      121 94 45
PROGRAM    FINE ART
□
      85 61 17
PROGRAM    BUSINESS
□
      180 206 124
```

Notice the computer prompted the user with the three previously entered student level descriptions (LD UD GD). Additionally, it used the discipline names supplied earlier (HISTORY etc.), and stopped automatically after the last line of data was entered. Maximal effort is made to reduce the amount of redundant information entered by the user.

Calculation

Upon the completion of the input of the requested institutional data, a series of calculation programs are executed which perform the computations required for system output. RRPM/NOW supports the short method of calculation, which in actual practice is used by almost all institutions now using RRPM. The calculation of certain items are automatically skipped if the associated input was omitted during the input phase. For example, staff salaries are not calculated if the staff information is absent during calculations.

The user executes the entire series of calculation programs by typing CALCSHORT. The user may execute any particular calculation program (e.g., calculate the Instructional Work Load Matrix - IWLM) by typing the name of the desired calculation program (e.g., CIWLM).

<u>Output</u>

RRPM/NOW produces an Organizational Budget and Program Budget which are modeled after the corresponding RRPM 1.6 output reports. It also has other output programs unique to RRPM/NOW, such as the Cost/Credit Hour Report and programs that display selected data upon command.

The RRPM/NOW version of an Organizational Budget for History is shown in Illustration 3.

For instructional purposes special consideration has been given to held the length of the output line to the number of characters which the system can display on a TV screen.

Illustration 3

BUDGET Output

ORGANIZATIONAL BUDGET FOR HISTORY

	SALARY	F.T.E.	PERCENT	COSTS	PERCENT ORGNL BUDGET	PERCENT INSTRL BUDGET
CHAIRMAN	20000	1.00		20000	3.03	.7997
FACULTY						
PROF	17000	8.56	20.00	145535	22.04	5.8192
ASSOC	14500	12.84	30.00	186199	28.19	7.4452
ASST	11500	12.84	30.00	147675	22.36	5.9048
INST	9500	8.56	20.00	81329	12.31	3.2519
TOTALS	13125	42.80	100.00	560739	84.90	22.4212
STAFF						
ALL	6000	11.20	100.00	67207	10.18	2.6873
TOTALS	6000	11.20	100.00	67207	10.18	2.6873
EXPENSES						
ALL				12503	1.89	.4999
TOTALS				12503	1.89	.4999
*** TOTAL		55.01		660448	100.00	26.4081

Illustration 4 shows the RRPM/NOW Program Budget for all four programs in the sample data.

Illustration 4

PBUDGET Output

PROGRAM BUDGET

INSTRUCTIONAL PROGRAM
BY STUDENT LEVEL

	COST PER STUDENT	NUMBER OF STUDNTS	PERCENT PROGRAM STUDNTS	PERCENT TOTAL STUDNTS	PROGRAM COST	PERCENT PROGRAM BUDGET	PERCENT INSTR BUDGET
HISTORY							
LD	1458.67	143.00	37.53	10.88	208590	32.91	8.34
UD	1625.20	186.00	48.82	14.16	302286	47.69	12.09
GD	2364.31	52.00	13.65	3.96	122944	19.40	4.92
TOTALS	1663.57	381.00	100.00	29.00	633821	100.00	25.34
BIOLOGY							
LD	1953.81	121.00	46.54	9.21	236412	36.19	9.45
UD	2359.33	94.00	36.15	7.15	221777	33.95	8.87
GD	4334.64	45.00	17.31	3.42	195059	29.86	7.80
TOTALS	2512.49	260.00	100.00	19.79	653248	100.00	26.12
FINE ART							
LD	1524.74	85.00	52.15	6.47	129603	48.33	5.18
UD	1667.46	61.00	37.42	4.64	101715	37.93	4.07
GD	2166.64	17.00	10.43	1.29	36833	13.74	1.47
TOTALS	1645.09	163.00	100.00	12.40	268150	100.00	10.72
BUSINESS							
LD	1496.10	180.00	35.29	13.70	269298	28.48	10.77
UD	1773.08	206.00	40.39	15.68	365255	38.62	14.60
GD	2509.33	124.00	24.31	9.44	311156	32.90	12.44
TOTALS	1854.33	510.00	100.00	38.81	945710	100.00	37.81

The remaining output reports are unique to RRPM/NOW. PFACULTY prints the faculty head count for each discipline. The head count is broken down by faculty rank and course level. Illustration 5 is an example of the execution of PFACULTY, again for the history department.

Illustration 5

PFACULTY Output

FACULTY RANK DISTRIBUTION HISTORY

	LD	UD	GD	TOTAL
PROF	[illegible]	4.6	1.2	8.6
ASSOC	[illegible]	7.0	1.8	12.8
ASST	4.1	7.0	1.8	12.8
INST	[illegible]	4.6	1.2	8.6
TOTAL	[illegible]	23.2	5.9	42.8

The output program PRCOST prints the report of the average cost per student credit hour produced. The costs are reported by discipline and course level. The average cost for each discipline, each course level, as well as the entire model are also reported, as shown in Illustration 6.

Illustration 6

DISCIPLINE DOLLARS / STUD. CREDIT HOUR

	LD	UD	GD	AVG
HISTORY	[illegible]	[illegible]	95.2	53.7
BIOLOGY	[illegible]	93.3	187.7	94.7
FINE ART	[illegible]	49.2	80.6	49.6
BUSINESS	40.8	[illegible]	90.7	58.2
AVERAGE	50.8	61.0	111.0	63.4

A general purpose data display program, SEE, can display both raw input data or calculated results. The user may ask for data to be displayed by using the name of the variable itself, as shown in Illustration 7.

Illustration 7

SEE Output (Faculty Salaries)

```
SEE 'FSAL'

FSAL--FACULTY SALARIES-------I10

(DISD  FRD  )
```

	PROF	ASSOC	ASST	INST
HISTORY	17000	[illegible]	11500	9500
BIOLOGY	17000	[illegible]	11500	9500
FINE ART	17000	14500	11500	9500
BUSINESS	17000	14500	11500	9500

In the output, the I10 is a reminder that Faculty Salaries (FSAL) are entered via input program I10. Alternately, the user may ask for the data associated with a particular program, as shown in Illustration 8.

Illustration 8

SEE Output (Data entered via IN1)

```
SEE 'IN1'

CLD   --COURSE LEVEL NAMES----   IN1
LD
UD
GD

SLD   --STUDENT LEVEL NAMES--    IN1
LD
UD
GD

FRD   --FACULTY RANK NAMES----   IN1
PROF
ASSOC
ASST
INST
```

In addition to the data shown in Illustrations 7 and 8, SEE can format and display the Induced Course Load Matrix, Instructional Work Load Matrix, student enrollment, as others as well.

Finally, the use can print the entire collection, or any part, of the data for a particular model via the program PRINTVARS. This program takes a matrix containing variable names to be printed, and produces an alphabetically-sorted listing of each variable's name, size, and contents. Illustration 9 shows an example of PRINTVARS output.

Illustration 9

PRINTVARS Output

```
PRINTVARS DNL 2

DISD     SIZE = 4 8

HISTORY
BIOLOGY
FINE ART
BUSINESS

ENRL     SIZE = 4 3

143 186  52
121  94  45
 85  61  17
480 206 124

ENRL IS THE LAST VARIABLE
```

Programming Language

The computer language used for RRPM/NOW is the APL (A Programming Language) notation, designed by Kenneth E. Iverson for the purpose of teaching mathematics. In 1968 it was released for public use by IBM and since then a group of dedicated enthusiasts has emerged and continues to grow. Recent years have shown a surge in the general availability and use of APL.

APL has many advantages over other programming languages that favor its use. First, the APL programmer needs to know very little about computers and how they operate internally. Thus he can concentrate his attention on the computational task without being a computer expert.

Second, APL is interactive in nature, rather than being batch-oriented. Consequently, the user can enter his data through a typewriter-like keyboard and if he makes a typographical error, APL identifies it and allows him to correct it on the spot.

Because APL is interactive, the user can use it much like a powerful desk calculator. For example, if he would like to see any given variable displayed, he only need types its name, say FSAL, for Faculty SALaries (which are arranged by Discipline by Rank, see Illustration 7). Because APL has many more operators than just +, -, ×, ÷, and is designed for matrix operations, he can do such things as determine the size of the FSAL matrix by simply typing ρFSAL. The result is the number of rows and columns in FSAL, which corresponds to the numbers of Disciplines and Faculty Ranks, (e.g., 10 Disciplines and 5 Ranks).

As the user becomes more familiar with APL he can interactively perform many different computations, on the spot, without resorting to time-consuming special programming. Consequently, the interactive nature of APL, its rich set of data operators, and matrix handling capabilities make it a powerful language for computations.

About the Authors

Drs. Sargent and Bell are Michigan State University faculty members whose efforts are directed at providing educational computer users with human oriented systems.

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A CASE FOR "CASE":

COMPUTER ASSISTED SALARY-SCHEDULE EVALUATION

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John L. Bristol

ABSTRACT: In today's complex world of school finance the public schools are finding assistance is needed in reaching the agreements necessary to operate in view of increased salary demands and decreased revenue. In this paper factors which have caused the schools to seek help are described, a general computer-related solution is identified, and then the specific set of computer programs which comprise the solution explained in detail. Finally, a simulation of a complete solution is presented as an example of the capability of the system identified as CASE, Computer Assisted Salary-Schedule Evaluation.

THE NATURE OF THE PROBLEM

The operation of public schools especially in the area of personnel management is in the throws of change. Negotiated agreements are replacing both board policy and administrative direction in setting working conditions for teachers and employees of public schools.

The results of negotiated agreements are just beginning to surface. School districts, faced with fixed revenues are being forced into settlements allowing for little, if any, financial flexibility. Many have settled contracts well beyond their ability to finance and consequently face the difficult issues of reducing staff and programs in an attempt to meet their obligations.

The best time to face such issues is during negotiations rather than years later after the alternatives and flexibility have been substantially reduced. To achieve this goal a system is required that can do the following:

1. Accurately and rapidly compute the cost of a particular salary schedule proposal, generate new salary schedules, and compare one salary proposal to another.

2. Flexibly provide such information without complex programming or equipment requirements.

3. Provide computer evaluation under the operation of a layman rather than a computer programmer or operator.

Without such a system, time-consuming hand calculation may be done with the possibility of computational errors greatly increased. Such errors may even cause agreement to a contract that cannot be afforded or, on the other hand, lack of agreement due to the time implications and the resultant frustration.

It may be that in some districts a large, batch-oriented computer is available for business applications and during negotiations it can be made available for assistance in computing costs of proposed schedules. Though such an operation is obviously reliable enough for the purposes needed, it may not be quick enough when the total elapsed time required to get the information from the negotiators to the computer, and back again is considered. For example, the system may be physically located at a site distant from the negotiations and time would be consumed in carrying data to and from the computer center. Additionally, the computer would have to be scheduled and available before the job could be processed. To make this possible, the current job the computer is working on would be completed, upcoming jobs would be suspended thus disrupting the regular operations. By the time all this takes place, it appears that, here too, a time lag would occur between the request for total cost data and receiving it. Consequently, even batch oriented computers may not produce the total cost data at the most opportune point in the negotiations.

In summary, calculators are logistically simple but slow and in the press of negotiations, apt to be inaccurate.

On the other hand, batch computers are fast and accurate, but due to logistics, including required computer expertise and sophisticated hardware, the results from these computers might be delayed in getting to the negotiators. Thus, neither calculators nor batch computers seem to offer the answer to accurate salary schedule total cost data at the most opportune point in the negotiations.

Consequently, there is more than a remote possibility that agreements may be reached without either party really being able to state accurately the total cost of the agreement or the percent of change related to previous agreements. In extreme situations it may be that even after an agreement is reached it will be found by one of the parties to be unacceptable because it was costed out in error and a return to bargaining will have to be requested with all the difficulties such a move involves. Consequently, the basic problem is that at present it is difficult to enable negotiating teams to receive an immediate, accurate evaluation of proposed salary schedule changes, and thus the process of agreeing is impeded.

A GENERAL SOLUTION TO THE PROBLEM

Because of the above recognition that salary bases of millions of dollars were to be computed by relatively inexperienced computer users under pressing circumstances, an integrated system of computer programs, identified as CASE (Computer Assisted Salary-Schedule Evaluation), was developed. Two major design considerations of CASE were to keep it simple to operate to reduce human errors, and make it operatable at the site of the negotiations to facilitate timely results.

CASE permits the user to (1) enter any salary schedule and accompanying people matrix, (2) compute the costs associated with such data, (3) modify the salary schedule and people matrix in virtually any way desired, and (4) compare the differences in costs of various schedules. This then meets the important computational needs for school salary negotiations. The use of the CASE system is described in the following sections of this paper. Actual examples of using CASE are presented as illustrations throughout the descriptions of the various programs.

SPECIFIC SOLUTION

Included in this discussion of the specific solution are the following topics: (1) entering data, (2) computing costs, (3) computing next year's expected costs, (4) computing differences, (5) modifications to salary schedules and people matrices, and (6) utility programs.

Entering the Salary Schedule and the People Matrix

The user desiring to enter a new salary schedule uses the program called SALARY. Through this program he is prompted for a name and a description of his salary schedule. This is done since it is expected that users will desire to enter more than one salary schedule for comparison purposes. After providing this brief description, the user is requested to type the schedule as it appears to him, that is, if there are 15 steps and 7 lanes, he types the seven salaries for Step 1, presses the return key, and repeats this same process until all 15 steps have been entered. There is no need to attempt to allign the columns (lanes) as the computer will do this automatically. On Step 16 he types OUT, and his unique salary schedule is then stored in the computer's memory, ready for use. By typing PEOPLE and repeating the above process, the people associated with the salary matrix may be entered into the memory of the computer. For an example of this process, see Illustrations 1 and 2. (Note: for purposes of illustration, an abbreviated salary schedule with four steps and five lanes is used. Enen though such a salary schedule is smaller than the case would ever be in a school system, it will serve as an appropriate example since a larger schedule would be manipulated and costed out in exactly the same method.) Underlining in the illustrations is used to indicate those portions of the illustration entered in the computer by the user.

Illustration 1

GENERATING SALARY SCHEDULE

```
SALARY
NAME THE SALARY SCHEDULE: S1
DESCRIBE S1: 1974-5 SCHED.
ENTER THE SALARY SCHEDULE ONE
STEP AT A TIME UNTIL COMPLETE.
TO EXIT, TYPE 'OUT'.
STEP 1:  7225 8225 8525 8825 9425
STEP 2:  7550 8575 8900 9225 9875
STEP 3:  0 8925 9275 9625 10325
STEP 4:  0 0 9650 10025 10775
STEP 5:  OUT

S1:  1974-5 SCHED.
7225 8225 8525  8825  9425
7550 8575 8900  9225  9875
   0 8925 9275  9625 10325
   0    0 9650 10025 10775
```

Illustration 2

GENERATING PEOPLE MATRIX

```
PEOPLE
NAMES:  S1
NAME PEOPLE MATRIX:  P1
DESCRIBE P1:  1974-75 PEOPLE
ENTER THE NUMBER OF PEOPLE IN EACH
OF THE SALARY SCHEDULE CELLS.
ONE STEP AT A TIME.
TO EXIT, TYPE 'QUIT'.
STEP 1:  5 20 1 0 [illegible]
STEP 2:  7 25 22 5 0
STEP 3:  0 21 2[illegible] 12 6
STEP 4:  0 0 1[illegible] 1[illegible] 1
STEP 5:  QUIT

P1: 1974-75 PEOPLE
[illegible]
```

Computing Total Costs

To compute the total cost of the salary schedule just entered, the user types TOTALCOST. He is given the option of naming the total cost result, e.g., B1. When the user so names a total cost, it is stored under that name so he may later compute the differences between various costs, or bases, if he so chooses. The total cost is then computed and displayed. For an example of the use of the TOTALCOST program, see Illustration 3.

Illustration 3

COMPUTING TOTAL COSTS

```
TOTALCOST
NAMES:  S1  P1
ENTER SALARY TO USE:  S1
ENTER PEOPLE TO USE:  P1
NAME THE BASE:  B1
1974-75 SCHED. × 1974-75 PEOPLE
S1 × P1 = $1,902,675
```

If greater cost detail is desired, COST is typed instead of TOTALCOST. This program produces the cost associated with each salary schedule cell, the step totals, lane totals, and the grand total as well. For an example, see Illustration 4.

Illustration 4

COMPUTING COSTS WITH MARGINALS

```
COST
NAMES:  S1  P1  B1
ENTER SALARY TO USE:  S1
ENTER PEOPLE TO USE:  P1
NAME THE BASE:  B1
1974-75 SCHED. × 1974-75 PEOPLE
S1 × P1 → B1 AS FOLLOWS:
STEP 1:   36125  ...       0 |  285875
STEP 2:   52850  ...       0 |  509150
STEP 3:       0  ...   61950 |  633850
STEP 4:       0  ...  140075 |  473800
-----------------------------------------
TOTALS:   88975  ...  202025 | 1902675
```

Thus by the use of the CASE programs SALARY, PEOPLE, TOTALCOST, and COST, the user can easily enter his data and compute the costs associated with these data. There are no practical limits on size, shape, number of salary schedules, or number of people matrices. Neither are they limited to whole dollars or people. A user may enter 1.75 people to indicate 1.75 FTE (Full Time Equivalent). Consequently the system accommodates those districts that recognize part-time positions.

Computing Next Year's Expected Costs

In considering costs for salaries for the coming year it is necessary to advance the people to the next step on the salary schedule. The program ADVANCE creates a new people matrix by moving everyone who is available to move one step down the salary schedule. It is often the case that certain individuals have reached the ceiling of their specific lane and consequently must not be further advanced. The program ADVANCE, by being responsive to the particular salary schedule indicated by the user, advances only those people who have not reached the ceiling in their particular lane. After the ADVANCE program has been used, the user may determine the expected total cost impact of one year's maturation. Execution of ADVANCE followed by TOTALCOST is shown in Illustration 5.

Illustration 5

COMPUTING NEXT YEAR'S EXPECTED COSTS

```
ADVANCE
NAMES:  S1  P1  B1
ENTER SALARY TO USE:  S1
NAME ADVANCED P1:  P2
DESCRIBE P2:  1975-76 PEOPLE
```

```
P2:  1975-76 PEOPLE
 0    0    0    0    0
12   20   10    0    0
 0   46   22    5    0
 0    0   48   27   19

TOTALCOST
NAMES:  S1  P1  B1  P2
ENTER SALARY TO USE:  S1
ENTER PEOPLE TO USE:  P2
NAME THE BASE:  B2
1974-75 SCHED. × 1975-76 PEOPLE
S1 × P2 → B2 = $1,952,425
```

Computing Differences

If the user is interested in determining the relative differences between various bases, he must have previously named them when computing the costs. If bases have been named, the user may then determine relative differences between bases by typing DIFFERENCE and entering the names of the bases. The computer will then provide the difference in dollars (e.g., $143,500) as well as their percent difference (e.g., 3.5 percent). Illustration 6 provides example of the execution of DIFFERENCE.

Illustration 6

COMPUTING DIFFERENCES

```
DIFFERENCE
KNOWN BASES:  B1 B2
ENTER BASES, OLD THEN NEW:  B1 B2
B2 EXCEEDS B1 BY $49,750
OR 2.6 PERCENT.
```

Modifications to Salary Schedules or People Matrices

Storing data and computing costs and their differences is only a part of the computational problem when negotiating a new contract. Quite often various salary schedules are proposed, and their resultant base costs must then be compared to facilitate decision-making. Often these alternate salary schedules are simple modifications of the original salary schedules. For example, an alternate salary schedule may represent an eight-percent across the board raise, or a $450 raise across the board, or perhaps $450 for Step 1 and $400 for all other steps. The program called MODIFY can be easily used to perform the above changes in the salary schedule. Additionally it can create new lanes or steps and delete existing lanes or steps. The same alterations can be made to the people matrix when new lanes or steps are added to a salary schedule which then necessitates changes in the people matrix. Such changes might include the subdivision of people into new lanes or steps so that the people matrix will correspond in shape to the modified salary schedule. Upon completion of the use of the MODIFY program, the user then has a second salary schedule for which he can compute costs, again using the programs TOTALCOST (or COST) and DIFFERENCE as previously explained. Such modification and subsequent costing is shown in Illustration 7.

Illustration 7

GENERATING A MODIFIED SALARY SCHEDULE

```
MODIFY
NAMES:  S1  P1  B1  P2  B2
SALARY OF PEOPLE TO MODIFY:  S1
NAME MODIFIED S1:  S2
DESCRIBE S2:  ALTERNATE SAL.
ROUND TO 0 PLACE ACCURACY.
'OUT' TO EXIT--
'ALL' DENOTES ALL STEPS/LANES
MODIFYING A 4 5 MATRIX
STEP(S):  2 3 4
LANE(S):  ALL
AMOUNT OF CHANGE:  400
STEP(S):  OUT

TOTALCOST
NAMES:  S1  P1  B1  P2  B2  S2
ENTER SALARY TO USE:  S2
ENTER PEOPLE TO USE:  P2
NAME THE BASE:  B3
ALTERNATE SAL × 1975-76 PEOPLE
S2 × P2 → B3 = $2,036,025
```

Utility Programs

A set of programs, grouped under the title UTILITY PROGRAMS, are included in the CASE system for the express purpose of simplifying operations for the user. These programs include assistance in startup of the CASE system, and displaying and changing the status of the user's various salary, people and base cost variables. The names of these programs together with a brief explanation of their functions are as follows:

Program Name	Function
INITIAL	Removes all old salary and people variables and readies the system for evaluation of a new set of salary schedules
LIST	Provides a list of variables and their descriptions.
SAVE	Provides the user with the opportunity to specify which variables are to be placed in off-line

memory.

DELETE — Allows the user to erase previously defined variables and their descriptions.

A BRIEF DESCRIPTION OF THE COMPUTER LANGUAGE USED FOR CASE

The computer language used for CASE is the APL (A Programming Language) notation, designed by Kenneth E. Iverson for the purpose of teaching mathematics. In 1968 it was released for public use by IBM and since then a group of dedicated enthusiasts has emerged and continues to grow. Recent years have shown a surge in the general availability and use of APL.

APL has many advantages over other programming languages that favor its use. The APL programmer needs to know very little about computers and how they operate internally. Thus, he can concentrate his attention on the computational task without being a computer expert.

Another advantage of APL is that it is interactive in nature rather than being batch orientated. Consequently, the user can enter his data through a typewriter like keyboard and if he makes a typographical error, APL identifies it and allows him to correct it on the spot.

Because APL is interactive, the user can use it much like a powerful desk calculator. For example, if he would like to see the people matrix (or any other variable) displayed, he only need type its name, say *P1*. Because APL has many more operators than just + - × :, and is designed for matrix operations, he can do such things as computing the total number of people in the people matrix by simply typing: +/+/*P1*. The +/+/ operators essentially put the + sign between all rows and columns of *P1* and adds them up. As the user becomes more familiar with APL he can interactively perform many different computations, on the spot, without resorting to time consuming special programming. Consequently, the interactive nature of APL, its rich set of operators, and matrix handling capabilities make it a powerful language for salary costs computations.

CASE COMPUTING EQUIPMENT

It has been established that "hands-on" computer access to provide immediate feedback during negotiations can facilitate the negotiating process. Traditional methods of "bringing the computer to the user" employ dial-up terminals. With these the user telephones a remote general purpose computer, which generally serves many users simultaneously. Recent breakthroughs in technology have made desk-top computers technically possible, and economically affordable. These are about the size of electric typewriters and serve only one user at a time. One such machine is the MCM 700,[1] the computer on which CASE was developed.

Important characteristics of the MCM 700 are that it is completely portable (22 pounds), and silent in operation so that it may be used anywhere ordinary 110 volt electrical outlets are available. It is small and light enough to be put into its carrying case and easily carried by hand, placed in automobiles, or under airplane seats, and later used wherever there is electrical power--board-rooms, classrooms or even at the breakfast table.

Another important characteristic of the MCM 700 is that being a self-contained computer, it is logistically simple to use. The user only need place the CASE cassette tape in the MCM 700, push the START button, and he has done all necessary preliminary procedures before running CASE. There are no telephone calls, sign-on procedures, or special computer instructions as with dial-up terminals.

As already mentioned, the MCM 700 uses cassette tapes for program and data storage. These allow for data security since the user may remove his tape containing sensitive data and take it with him. The programming language available is a sophisticated version of APL, which facilitates interactive computing and extra on-the-spot data manipulations such as described earlier. The output is displayed on a one-line display screen, and a light-weight printer is optionally available to create permanent paper copies of the output. Although the MCM 700 is adequate for all salary schedule computations, a user may wish to use the increased computing power of a large computer for other purposes. If such is the case, the MCM 700 can optionally function as an intelligent dial-up terminal to a general purpose computer.

---

[1] Micro Computer Machines, Inc., 1765 Shawson Dr., Mississauga, Ontario, Canada (416) 671-0460.

ABOUT THE AUTHORS

Drs. Sargent and Bell are Michigan State University faculty members whose efforts are directed at providing educational computer users with human oriented systems.

Dr. Bristol is Superintendent of Independent School District #196, Rosemount, Minnesota, and actively pursues innovative computer applications in education. Dr. Bristol's extensive salary negotiating experience was instrumental in the development of CASE.

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A LOW COST APPROACH TO ON-LINE COMPUTER SYSTEMS

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ABSTRACT. What would you think of a computer system that had 80,000 terminals? How big a computer do you think would be required to process students everyday, any day of the year for registration? How big a computer do you think would be needed to process at the same time as student registration, all the school's accounting, all the school's payroll, personnel and other reports? What do you think of a computer system that would provide a registration system for students that at its optimum requires only the time of a student to make a telephone call, write out his money on a check and stick a postage stamp on an envelope? Does this system sound like a large system that would cost a fortune that only some very wealthy junior colleges could afford? Well, it is not. This is a system that Joliet Junior College has, through three main components, a mini-computer, the U.S. post office, and Illinois Bell. An on-line registration system using all three components provides for an absolute minimum effort by the students to register and a maximum amount of information collected with a great degree of accuracy and a minimum of effort by college staff.

A key element in the system is the low-cost mini-computer. The system that the Joliet Junior College has purchased is a 4-Phase system. Although mini in name and in price, the system supports large-disk capacity and 19 terminals. Instead of beefing up their old computer, to a large memory with large disks, the college decided to join the growing concept of what is called distributed computing. Joliet Junior College kept its old system (a batch system) and added to it a mini-computer to provide the on-line processing.

This concept of distributed computing can be best illustrated by a story that Grace Hopper tells -- "out West in a lumbering operation they go in and cut down all the trees, load them on a sledge, and haul them out with a tractor. They don't do that way in the state of Maine. There they cut out a particular tree, and they snake it very carefully around the others, not to damage them. They don't use tractors: they still use oxen, and when one ox just can't budge a tree, they don't try to grow a bigger ox, they don't send for an elephant or a dinosaur, they use two oxen. I think this tells us what we must do in the future. Within the next few years, when you go to get computer power, you'll not get a large computer system; you'll be getting a system of computers.

Joliet Junior College has purchased the two oxen instead of getting the larger oxen. We will continue to use the one system for education, for many small batch systems, and other long print jobs. The mini-computer will be used for on-line processing of student records, payroll, personnel, and accounting.

In addition, the college took another route in the development of the software for the system. Instead of adding staff, the college purchased the software from a firm, Midwest Systems Group, Inc., who then tailored all the systems of the on-line nature to the 4-Phase computer. By using a software house to do the programming, the on-line computer was installed practically overnight. In fact, the system was installed on November 12, and on November 17 full-scale, on-line registration began. Included in those 5 days were a weekend and a holiday. The software firm did all the on-line programs. The Junior College programmers were responsible for doing all the batch programming. In addition, data can be transmitted by a communication line from the 4-Phase to the other computer. Thus all existing programs that were written in previous years can still be run.

The software firm developed the data base in consultation with the college staff. The data base includes all data elements that are recommended by NCHEMS and state requirements. All data files are stored in the newest concepts of data base management that feature fast and easy retrieval of data elements and efficient utilization of disk storage.

First, to fully understand the on-line system, let us go step by step through a registration of a student. At Joliet Junior College there are basically two kinds of students -- the regular, full-time student and the part-time student. Joliet Junior College has an enrollment of 12,000, of which 3,000 are day students. The day students follow a slightly different path than evening students.

Let us start with the day students. All full-time students are required to have an academic advisor. The student schedules an appointment with that advisor prior to the beginning of the semester. At this time the advisor gives the student counselling information on what courses he should be taking. While looking over the course schedule in the advisor's office, the student selects, with the advisor's approval, the courses he wants. The advisor then calls the telephone registration system with the courses the student wants.

In front of a terminal at the other end of the line there is a girl who is answering the telephone call. She then enters into the computer each of the course selections, verifying that there is space available in that class, verifying that there is no time conflict in the schedule, and that the student has the required labs and discussion groups for certain lecture courses. All this verification is being calculated and displayed automatically by the computer. At the same time the student's demographic information is also displayed, so that the operator can then go through and verify the accuracy of the student's address, residency, race, sex, advisor, etc. Upon completion, the student is registered in his desired classes and will receive his schedule through the mail. He needs to do nothing further. The telephone call has taken approximately two minutes.

The demographic information of the student has been put into the system at the time the application is received. The time-consuming data collection of name and address is done one time only for that student in his history.

While the student is registering for classes, several unique features of the system may be demonstrated. For example, if one of the classes is closed, or there are no seats available, the terminal operator can display all other courses of the same name and title that are meeting that are not closed, and that do not conflict with courses he has already signed up for, thus making the search for that difficult-to find class much easier.

Another feature is to check for time conflicts. Previously, many students, inadvertently scheduled classes at the same time. Now the computer automatically checks for that and does not allow them to do so unless specific override information is given.

If the student is a part-time student, he needs only call from his own home and request the course he wishes to take. The same telephone operator who took the information from a full-time student takes the call from the part-time student. The same features are given to the part-time student regardless of what kind of course he is taking.

Thus, we say we have a system with 80,000 terminals. A student merely has to pick up his own phone and call the college to be registered. At some point later in time he will be mailed a schedule with all his billing information on it. To be completely registered he simply needs to return that schedule by mail with payment enclosed. Of course, if a part-time student needs counselling, information is made available to him if he comes to campus to see advisors or counsellors.

The college has carried the on-line registration system to the point of student receivables. Whether the student decides to return payment by mail, which is encouraged, or decides to come and pay in person, his financial collection is done through a terminal verifying the exact amount of money that he owes the school. Financial aids, such as state scholarships, local loans, local scholarships, etc., are put into the system for that student prior to his payment. Thus, when he comes to pay in person, or by mail, he pays exactly what he's supposed to. The terminal operator retrieves the student and enters into the terminal the amount of money being collected by check, by cash, or by certain types of financial aid.

A complete ledger of all financial transactions for a student is kept so that reports can be generated later showing amount paid, amount owing, the type of scholarship, and the amount of the scholarship. The system also provides for automatic billing every night for students who add classes, or the automatic printing of refund checks for those students who drop classes and are entitled to refunds.

The time spent by most students ordinarily involves only a very few minutes in registration. They can call the college and register for their classes, a few days later they will receive their schedule and bill in the mail, write out a check, enclose it in a self-addressed envelope, and mail it back. There are no long lines to wait in, there is no need to come to campus: just be there the first day of class.

This system is particularly useful at Joliet where we have many branch campuses spread out over a large area, with some campuses located as much as 60 miles from the main campus. Thus, the convenience of registering by telephone rather than a long drive is very beneficial to the students. Because such a large portion of the college population is part-time, we believe that the ease of registration for part-time students has greatly increased the number of part-time students attending the college.

The telephone registration room which accommodates all types of students for the registration is manned by employees who sit with a telephone and a computer CRT in in front of them. There are eight employees working at the height of the registration period. During other times the number can go down to one, or two, but always a part-time employee. This registration system is open from 7.30 in the morning till 10:00 in the evening every single day that the school is open. The college has been adopting a much more flexible scheduling policy. Classes start and stop at many times during the year. With advance registration beginning very early, the registration process never ends. It is continuously on-line. Continuous on-line registration is possible because the system can support the other on-line systems at the very same time registration is going on.

The student financial system is integrated with the registration system. It provides a complete on-line student receivable ledger for each student. Tuition, fees, and financial aids are automatically handled by the system. The ledger will contain payments made directly to the bookstore for expenses which are included in and a part of a given financial aid. Moreover, payments made directly to the student for boarding, meals, transportation and miscellaneous expenses are also maintained by the system. Payments are recorded by cash, check, charge and by voucher type, or any combination thereof.

Major features of the system include:

- Immediate fee payment reports by cashier which will include:
  - Breakdown by revenue category
  - Payment type: Cash, check, charge, financial aids (also by type)
- Accountability of payments made to student for major federal and state programs: i.e.,
  - BEOG
  - LEEP
  - SEOG
  - Nursing Loans and Scholarships
  - ISSC
  - IVS
  - Local Awards
- Automatic generation of tuition refund checks and corresponding entry into the accounting system
- Listing of student insurance payments
- Billing reports for federal, state, and local programs
- Exception reporting for students using G.I. Bill
- Immediate availability of all information pertaining to student's financial status is provided on-line.

At the same time registration is being processed through the computer, budgetary accounting and payroll systems are also being processed by the computer in an on-line mode.

All accounting information is put into the system. Purchase orders, invoices, receipts, budgets, transfers, imprest checks, and all debits and credits required for complete accounting are entered through terminals into the computer.

The key feature in this system is that the status of a particular budget is known in a real-time mode. Purchase orders and other financial transactions cannot be issued if that particular budget account does not have sufficient funds. This up-to-date control of expenses is crucial to the college which operates with a balanced budget and limited resources.

Other highlights of the accounting system include:

- On-line immediate updating of all accounts
- Immediate availability of account balances
- On-line entry of purchase requisitions for computer-generated purchase orders
- Accounts payable check writing
- Open purchase order listings
- Order Address and Remittance address on vendor file
- Budget projections up to four years by user defined parameters
- Complete audit trail
- Comprehensive Balance Sheet
- On-line processing of imprest checks/printed daily
- Budget creations on-line with historical data displayed

The system that requires the most accuracy in any organization is payroll. By entering all transactions such as hours worked, deductions, rates, etc. on the terminal, the correctness of payroll data is guaranteed.

All maintenance is performed through terminals with an immediate full audit trail. An extensive series of batch reports is also included as part of the system. The many variations which the payroll system accommodates include:

- Pay cycles which may vary from

once a week to any other period the institution may desire

- Rerun capability without restoring the payroll master file
- Ability to charge one employee to many different accounts for cost distribution
- Automatic termination of payments upon completion of an employee contract
- Deductions for various pension programs with fiscal year totals
- User controlled deduction processing
- Automatic interface with the accounting system

A relatively small system that Joliet has on-line is the inventory system. This control system maintains records on all college equipment and furniture. Inventory listings are produced at the request of the user. The inventory system includes:

- Inventory listings by department
- Inventory listings by equipment category
- On-line ability to add or update inventory on the data base
- Maintain insurance information on various equipment

The new computer system at Joliet Junior College has solved many problems and is enthusiastically endorsed by the administration. This exemplary system has been visited already by many colleges. It is a model for future collegiate systems development.

USING THE STATISTICAL PACKAGES FOR THE UNIVERSITY ADMINISTRATION AND HOSPITAL DATA PROCESSING

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ABSTRACT. The modern computerized information systems in a university environment, such as student records, personnel, patient records, etc., have provided a great deal of sources that can be statistically analyzed to provide the administrators and researchers with very important prospective information. By taking advantage of the existing statistical packages commonly used in the educational research and instruction, such as SPSS, SAS, OSIRIS, etc., these administrative data bases can easily be analyzed to obtain much valuable information which may not be available in the original programming of the data base.

There are three principle areas to be considered when the data bases are to be analyzed statistically. 1) the prototype and the data transformation requirement between the data base structure and the statistical packages, 2) general statistics selection for the data base, and 3) selection and limitation of the statistical packages.

This paper intends to generalize the certain techniques required to perform the statistical analysis of the data base with respect to the above considerations.

Introduction

Among the university community, there have been two (2) major developments as far as data processing is concerned. One is the increasing amount of computerized information systems for administrative use; the other is the availabilities of statistical packages for research and instruction that have been greatly increased.

It is obvious that a computerized data base system normally provides a great deal of information, which is vital not only to an administrator but also to a research educator. For example, when a group of students are admitted to a University, the background and academic record of these students are recorded for various administrative uses. The administrator and educator would certainly like to know the valuable information such as what is the academic performance of these students as compared to their high school percentile rank, or as compared to their high school percentile rank, or as compared to their SAT or ATC score. Obviously, this type of information can be obtained from the information data base with various statistical analysis techniques.

Today, the statistical packages, such as SPSS, SAS, OSIRIS, and etc., are commonly used in a University for scientific computation and provides the following attractions:

1. It has a wide variety of statistical computation for selection ranging from elementary to advanced statistics.
2. It offers great flexibilities on data transformation and file input/output.
3. It is easy to use.

It is naturally these statistical packages that can be adopted to use for the statistical analysis of the data base. Simply because it requires only a minimum amount of effort to accomplish a great deal.

There are, however, three (3) principle considerations that must be examined when the data base is to be analyzed with the statistical packages:

1. It is generally required that the data transformation of the data base to a fixed sequential data structure is used among the statistical packages.
2. The general statistics selections depend on the available information in each data base.
3. Principally, there are limitations among each statistical package.

It is generally worthwhile to examine the data base with the above considerations in order to obtain the sensible statistical information of the data base.

Data Transformation of Data Base

In most of the statistical packages, the file input/output structure is mainly a sequential access method with a fixed length of record. However, the common data structure of the data base may be one of the following access methods; direct access method (DAM), indexed sequential access method (ISAM), virtual sequential access method (VSAM), or other specially designed access methods like AMIGOS and etc. In some cases, the record length of these data bases may be variable or undefined. It is then required to perform the data transformation of the data base to fit the requirement of statistical packages.

Normally, there are two (2) steps to consider:

1. The transformation of other access methods to sequential access methods may be achieved by a utility program generally provided by a computer manufacturer. For example, the utility program IEBISAM, is to be used to unload the ISAM file to SAM file in the IBM computer. When there is no available utility program, a special program is needed to be written.
2. When the data information is variable or undefined record length, it is required to rechange to the fixed length record size. In most cases, a special program is needed to solve the problem.

Among the statistical packages, there are many additional data transformations that are provided. For example, within the SPSS package, it provides features such as data recording, arithmatic computing, etc.

General Selection of Data Base Statistics

Generally, the need of the statistical analysis for the administrators use need not to be complicated, whereas for the researcher there may be more advanced statistical techniques involved. The following are some of the typical examples to describe certain statistics used for the administration and hospital data base:

1. Descriptive statistics: The one way frequency distribution is normally used to describe the basic population study. For example, the student information data base is used to study the total population distribution of students in terms of geographical location, sex, major, grade point average, etc. Another example, the hospital information can be also used to study the total population distribution of patients in terms of geographical location, sex, age, symptom classification, load of doctor, and etc. In many cases, the sub-population study can also include to test the mean different. For example, it will be interesting to know what are the grade point average differences of the student in different majors or sex.
2. Measure of association: The cross tabulation is a joint frequency distribution of population according to two or more classificatory variables. The joint frequency distribution is tabulated in the form of contingency table, and can be statistically analyzed by certain tests of significance to see whether or not the variables are statistically independent. For example, the student information system, a joint variable of sex versus other variables like major, minor, degree sought, etc., are to be studied to see the status of academic standing between male and female. Another example is the hospital system, it is essential to know a joint variable of hospital service versus sex, age, to see what type of hospital service is provided for various types of patients.
3. Bivariate correlation analysis: The bivariate correlation analysis provides a summary description of the relationship between two variables. The correlation coefficient is to represent the degree to which one variable is related with other variables. An example is the student information system. The relationship between the students high school percentile, or ACT score, and grade point average can be correlated to see if there are indeed relationships existing. In another instance, the bivariate can also be analyzed in the form of regression analysis. It is a statistical technique to analyze the relationship between a dependent variable (say; SAT or ACT score) and an independent variable (grade point average).
4. Analysis of variance: The analysis of variance is to obtain analysis of variance for factorial design. For the possible effects of a single factor, the analysis is a one way analysis of variance. For the simultaneous effects of n factors, the analysis is n-way design. In a student information system, the high school percentile can be considered as a factor to perform one way analysis of variance to see the effect of the grade point average, ACT and SAT scores within different classifications of percentiles.

The above four (4) examples of statistical techniques for data base are considered very common statistical problems. With these analyses, the educator can now obtain other additional information to see many educational problems prospectively. Essentially, these analyses can also be applied to many other data systems, such as personnel, financial data base, etc., for whatever analyses are needed.

As mentioned earlier, the need for the research may require more complicated statistical analysis, such as factor and discriminate analyses.

Limitation and Selection of the Statistical Packages

Obviously, there are limitations among the statistical packages. To examine the limitations, the following parameters are usually considered:

1. What are the maximum number of variables and and maximum number of cases that can be run at the same time. It should be noted that as the number of variables and subjects increase, more computer resources are required.
2. Specific limitations to obtain each specific statistical analysis.
3. What are the limitations of file input/output and data transformation.

Normally, the selection of the statistical packages depends on four (4) factors:

1. The type of statistics one wishes to obtain.

2. The limitation is not to exceed what one wishes to do.
3. The input/output file structure are flexible.
4. The program is easy to use.

Summary

Most of the statistical packages are designed to run in a batch system. Consequnetly, it cannot accommodate to use with a data base on-line monitor. The statistical analysis of a data base can prove to be very benefical to the educator for the simple reason that it requires only a minimum amount of effort to obtain a great deal of information usually not provided by regular data base programs. The statistical information obtained may need more understanding of the statistics by the administrator.

Although, the data security is an important issue for the data base management hence, the statistics of the data base is also very sensitive. However, this is beyond the scope of this paper to discuss the security details.

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INFORMATION - THE SYNTHESIS OF DATA

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ABSTRACT. In the relatively short span of twenty plus years, Educational Data Systems have evolved from manual approaches to Integrated Information Systems. Parallel to this evolutionary progress in processing systems has been an increasing realization that unsynthesized data does not meet the challenges of "Management Information Systems". The requirements of today's systems demand Information not Data.

This paper - Information - The Synthesis of Data - traces the evolution of data systems from manual methods through M.I.S. It explores the development of standalone applications and their relationship to the Integrated Information System. Self-contained data files, redundant data and generic problems in user and data processing departments are explored. A methodology for assessing cost justification/benefit analysis is presented. The paper concludes with a discussion of the benefits of data base systems and the role of management in the development of Information Systems.

Todays educational data processing systems have gone through a series of evolutionary steps beginning with the manual methods of collecting, storing and processing data. With the advent of unit record equipment, much of this data became processed via the punched card. The early 1960's saw the 1401 (or second generation of computer) take over a large part of this application processing. This was replaced in the late '60's by the System/360 and in the 1970's by the System/370. The approaches to data processing did not significantly change in the early years of automation. The manual procedures were automated for use with punched cards. With the 1401 came the advent of the application program, and a movement towards designing systems to utilize the machine as opposed to automating existing manual procedures. The System/360 (or third generation of computer) provided increased efficiency and capability for these application programs. With the advent of System/370, many educational institutions moved from standalone applications approaches, to the concept of the integrated information system.

The philosophy of data processing has changed in parallel to both the hardware and software developments. It has moved from the concept of people doing the work in the manual methods; through the concepts of machines replacing people, which was the typical philosophy of the punch card era. The philosophy then moved through the concept of machines do "people work" faster than people do, to the concept of machines doing "people work" more efficiently. It culminated in the concept of machines being tools for people to do their work more effectively and efficiently, i.e. the integrated information system.

Today, many educational institutions are too small to justify computing power on their own campuses. These institutions tend to pool their resources into regional centers for data processing support, or remain with the manual or punch card approaches. A large number of them have followed the evolution given above, but remained at the level of application oriented systems. These are computer systems for particular purposes, i.e., a payroll system, an accounts payable system, a student scheduling system. These application oriented systems typically run in a batch processed environment. Many of these users have not redesigned or resystematized their approaches since the days of 1401. As a result, a great deal of inefficiency and underutilization of the technology of System/370, hardware and software is a common occurrence. A small number of leading edge school districts have embraced the concept of the School Information System and are in varying stages of development of this type of integrated approach to data processing.

Let us expand further on the concepts of separate applications for the middle group of school districts. These are characterized by separate applications, e.g. scheduling, census, attendance, vehicle scheduling, student testing, or student records. These applications were independently developed, typically each with their own files, file structures, access methods and procedures. As a result, it is extremely difficult to interface them e.g., the accounting system, to the payroll system. Since each applications has its own files, a great deal of data redundancy exists. For example, the student identification necessary in student records will be repeated (in whole or part), in the scheduling application and in the student testing application. This identification information may also be repeated in the attendance, census, and vehicle scheduling files. Data redundancy results in a great deal of data maintenance activity, to be certain that an update to one file is made to all files containing the redundant data.

As a further illustration of the concepts of data redundancy, consider the payroll and personnel applications of a school district. A payroll record may well contain information on the employee's identification, positions and assignments, salary agreements, address, etc., Another application, salary simulation, also requires employee identification, and may, in addition, require educational background, employment history, position assignments, etc. The position control application also requires employee ID and position assignment, as well as budget references and salary agreements. Looking at the three applications, payroll, salary simulation, and position control, we find redundancy of employee ID, across all three; redundancy of position and assignments, across all three; and redundancy of salary agreements between payroll and position control. In the typical application oriented shop, the three applications would each have their own files and have duplication of data for all of these items.

Many other problem areas tend to emerge as "universal problems" (in varying degree) in school districts throughout the United States. These may be grossly classified as problems in the user areas, and problems in the data processing area. Let us consider these problems one at a time.

Some of the problems discovered in user areas can be categorized as problems with current operational systems. For example, the application-oriented technique precludes the ability of a user to merge information that exists in separate files without needing to write new programs that bridge these files. In the absence of the ability of the user to juxtapose data without new programming, the current operational system is seen as inefficient. This may be categorized as the "generic" problem of unsynthesized information. One school district superintendent informed me, that his greatest requirement for an information system was the ability to juxtapose any two pieces of data that he knew resided in the computer, but was unable to put side by side for management analysis.

Another typical problem seen in the user area is the provincialism of individual users which precludes allowing "their files" to contain information not necessary for "their application". An example of this would be the payroll department not allowing a budget reference to be inserted in each payroll master record, since budget references are a function of the budget department. The lack of system-wide point of view, the nontreatment of data as an institutional resource, increases the problems of data redundancy.

An all too frequent problem associated with both users and data processing departments in educational institutions is the lack of sufficient benefit analysis before deciding to write a new computer application or modify an existing system. I am aware of one school district that spent more money modifying their payroll system to handle unusual check situations, i.e., employee hired in the middle of a pay period, then the gross amount paid to all employees falling into that category over a two-year period.

The lack of perspective by most users of the magnitude of the development effort required to move from the application oriented shop to the school information system is yet another problem area. This problem manifests itself in complaints about "why isn't the new system up yet," when the new system is so complex, that it requires significant development time.

Problems discovered within the data processing department of many school systems include those of a "if it feels good, let's do it" development attitude. This reflects a lack of review of the scope of a development activity or consideration of the value of including a particular procedure or data element versus its cost in the development process. Another problem discovered in most data processing installations is the failure of the data processing shop to carefully consider the "non-people factors" of the development process, i.e. availability of machine time for program development and testing.

Another area of data processing difficulty is found in the attempt to coordinate the technical direction of an installation. It is ludicrous for one development group to be building application programs to run in a DOS environment, while the systems programming group is working on migrating from DOS to OS/VS. Also, the operational environment must be considered in the development of a new systems approach. Using a 370 to run 1401 programs under emulation is hardly conducive to taking full advantage of the technology available.

Data processing has become a labor intensive industry. As such, constant review of skills mix and staff capability must be accomplished in order to avoid obsolesence of skills that hampers development of new systems approaches.

In summary, today's fragmented approach to application programs, where-in each subsystem operates through its own files, and interaction is achieved through manual file interchange, has resulted in data security and consistency problems and operations that work under the principal of maximum parallelism.

One must be careful not to draw the conclusion from the preceding discussion of problems encountered in todays operational systems that these problems are unique to educational institutions, or particularly school districts. In fact, the problems encountered are just as applicable in the business community. The information requirements of the top management of any organization are highly similar.

Another approach to the common history of data processing in both education and business can be seen in the process emphasis changes over time. In the 1965 timeframe, the daily processing or operational systems were the major use of data processing. This moved forward to operational control systems in the early 70's, and is moving towards the concept of policy planning and use of computer based information systems in the management process. In effect then, the growth has gone from transactions, through information requirements, to the information requests capability. For example, a transaction that involves enrollment of students, resulted in operating reports on census as part of the daily processing. In the early 1970's, reports that included statistical breakdowns of enrollment categories and census categories provided the operational control for the middle management of the school district. Today, the top-level executive needs to be able to do analysis and projections of enrollments, on a demand basis, from the same data base that is providing those operational reports and the summary reporting.

The information needs of the top-level executive demand particular qualities of information. It must be easily accessible, timely, possess minimal redundancy, be accurate, and be centrally available, so that it may be combined with other pieces of information to provide meaningful reports. The concept of lack of access to information, so prevelant in the past, i.e., "it's in the computer, but we don't have a program to get it," or "it must be sorted," or "it's in a manual file but we don't have that on the machine," or yes, "we have that information, but the updates have not been distributed," are no longer acceptable. Furthermore, budget reports that are months late or the absence of class lists for the first month of a semester are intolerable.

In addition to the qualities of information previously mentioned, recent federal legislation, including public law 93-579 and 93-380, demand increased awareness of the security and privacy of information aspects of school records. The centralization requirement stated for the information system also carries with it the burden to guarantee that the information is not inadvertently modified or destroyed.

In order to service all levels of the school district, the computer must support both the operational systems and the management use of information. A good technique for establishing the school's information system then is to first examine the primary processes of the institution, regardless of organizational constraints. For example, in addition to goals and objectives, an educational institution has an instructional process and a support process, both of which interface to a quality assurance procedure and have financial processes co-requisite with them.

The operational processes of a school district typically center about the six major areas of student, finance, personnel, certification, federal programs, and materials. In the design of a school's information system, one school district redefined these into seven major subsystems. These were finance, personnel, facilities, materials, pupil, instruction, and management planning. One can easily note the parallel between the subsystems and the operational processes needing support. These seven subsystems are linked together by a generalized information retrieval capability, providing the ability to juxtapose data regardless of the subsystem from which it was derived. Within each subsystem reside the specific operational applications necessary to perform the processes defined for that subsystem. For example, within the pupil subsystem resides the student scheduling application; within the financial subsystem resides the accounting and budgeting application; within the materials subsystem resides the purchasing and inventory applications.

Returning to the problem of lack of benefit analysis, one can attribute generic benefit categories to virtually all applications performed in school systems. These fall in the following areas:

- Better Planning
- Operational Control
- Orderly Growth
- External Reports
- Less Staff Work
- Avoiding Duplicate Files
- Easy Recovery
- Better Inventory Control
- Better Purchasing
- Better Facilities Utilization
- Improved Student Services

Improved Staff Services
Superior Faculty
Better Course Offering
Better Schedules
Improved Instruction
Assist Faculty
Assist Students
Improved Counselling
Improved Placement

For each application, within each subsystem, one can draw upon the generic benefits that would apply. For example, consider the area of student scheduling as an application with the pupil subsystem. Potential benefits for this application include better scheduling, orderly growth, less staff effort, avoiding duplicate files, easy recovery, better facilities utilization, better student schedules, better course offerings, improved instruction, saving of student time, and saving of faculty time. In attempting to create, or purchase, a new student scheduling application, each of these potential benefits should be weighed and quantified. One may then apply a probability factor of receiving the potential benefit to be achieved. When compared to the cost, one can quickly determine whether or not a particular application is cost justified.

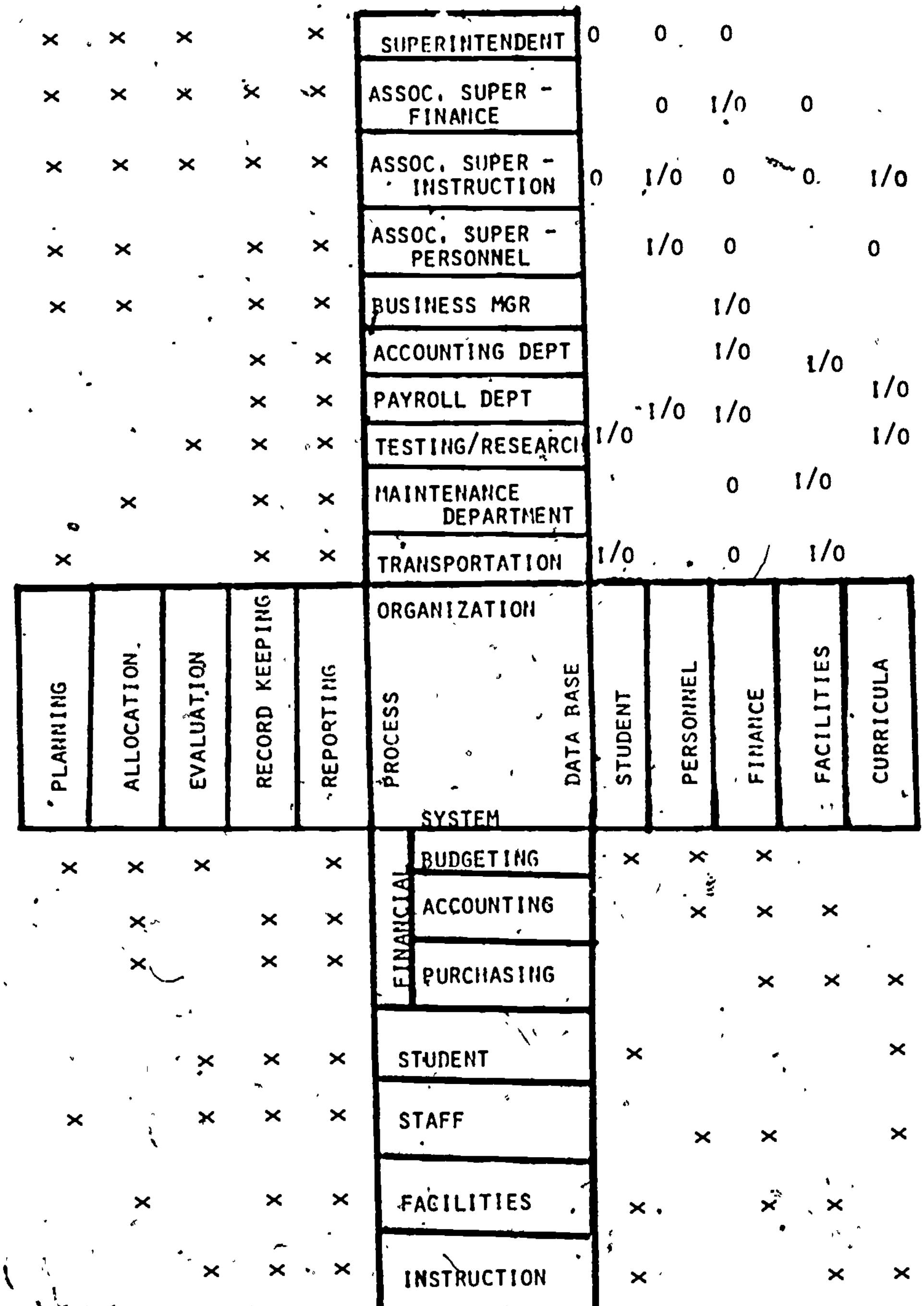
Recognizing that many of these benefits do not fall in an easily quantified (in dollars) area, one could attribute relative rank to the benefits, and prioritize application development based on the average rank of benefit to be achieved. For example, if there is a high probability that significant clerical effort could be avoided by a student scheduling system, one might attribute a 5 to the benefit value. If it is at extremely low probability that instruction will be improved by a new scheduling system, one might attribute a one or a zero. If these were the only two benefits, the average benefit would be three.. Similar analysis for other application areas would then give a uniform basis for comparing potential benefits in the development of the school's information system.

Given that the school's information system will accomplish the operational and indeed functional processes previously given, one must be certain that the development of the information system also accomplishes the management oriented processes of goal development, strategic planning, tactical planning, allocation of resources, measurement or assessment, external relations and conflict resolution. The author contends that conflict resolution is not an automatic byproduct of the school's information system.

A technique, commonly referred to as an "iron cross matrix," is extremely useful in relating processes to systems, organizations and data. The attached illustration depicts such an iron cross. Note, for example, that the process of allocating is accomplished by six departments; that of the superintendent, the associate superintendent of finance, the associate superintendent for instruction, the associate superintendent for personnel, the business manager, and the maintenance department. In addition, the allocation or budgeting process uses the budgeting, accounting, and purchasing systems and the facilities system. One could also find that the maintenance department receives output from the financial data base and provides both input and receives output from the facilities data base. The facilities data base supports the accounting system, purchasing system, facilities system and instructional system. One can follow the "iron cross," in a clockwise motion, to find which processes are performed by which organizations, using which data bases and which computerized systems. Perhaps the key to the understanding of the "iron cross" does not lie in the specific data items used, but in the absence of an entry. For example, one finds that the student data base is not related to the accounting application and does not interest the accounting department for either input or output. It is the study of the holes, as well as the X's, that enables the designer of the school's information system to insure that the systems developed, and data bases provided, support the vital processes of the organization, and provide the tools for each of the operational organizations to do their job. It is also vital to remember that organizations are dynamic, processes more static. As such, one should build a school's information system such that it is insulated from periodic organizational change.

Key to the availability of a school's information system is the centralized repository of data referred to as a data base. This may be defined from a data processing point of view as: "A nonredundant collection of interelated data items, processible by one or more applications, by the integration and sharing of common data." This may also be defined from the users point of view as, "A collection of existing and/or planned data, available to the user as if it were a single integrated data base, regardless of actual physical description." Perhaps the simplest way of describing a data base system is "One that allows multiple independent (human) users to have concurrent access to a central repository of information."

Conceptually, the data base may be viewed as similar to an organization chart or a hierarchy of the organization. The concepts of man/manager relationship is thus analogous to that of parent/child data segments. The superintendent sits at the top of the organization chart. The employee root record or root data segment, sits at the top of the personnel data base. Using this


SUPERINTENDENT
ASSOC. SUPER - FINANCE
ASSOC. SUPER - INSTRUCTION
ASSOC. SUPER - PERSONNEL
BUSINESS MGR
ACCOUNTING DEPT
PAYROLL DEPT
TESTING/RESEARCH
MAINTENANCE DEPARTMENT
TRANSPORTATION
ORGANIZATION
PLANNING
ALLOCATION
EVALUATION
RECORD KEEPING
REPORTING
PROCESS
DATA BASE
STUDENT
PERSONNEL
FINANCE
FACILITIES
CURRICULA
SYSTEM
FINANCIAL
BUDGETING
ACCOUNTING
PURCHASING
STUDENT
STAFF
FACILITIES
INSTRUCTION

single data base, one can support numerous applications required in a personnel subsystem. For example, the areas of salary simulation would require a view of a subset of the data base. The payroll application would require a different view of the data base. The value of the data base system is that once entered in the original composite data base; data is available for any application that requires the use of said data base. The programmer need not be concerned with the absence of presence of data or its logical or physical storage requirements. It is the data base administrator, using the data base system, that provides a logical view of the data base for each application program within the processing subsystem.

Returning to our concept of benefit analysis, one school district found that the benefits of an automated personnel system, using a personnel data base, consisted of the following:

- Automatic Contract Writing
- Automatic Re-appointment of Teachers
- Automatic Salary Calculation
- Recorded Audit Trail
- Machine Readable Data for
  - Bank Reconciliation
    - Credit Union Deductions
    - Insurance Deductions
    - Retirement and FICA Deductions
- Current and Accurate Faculty Rosters
- Data Security
- Increased Payroll Accuracy
- Improved Data Turnaround
- Terminal Operator Accountability
- Reduced Data Handling
- Centralized Data
- Automatic Analysis Retrieval Capability
- Better Human Communications

In addition, this school district found that the cost of development of the system totaled $61,000, which included six months to design, code and implement. Utilizing this system has resulted in an operational savings of $11,000 per month.

Data base systems support online terminal access while providing the data security and privacy necessary in a centralized system. Most data base systems provide backup and recovery capability which will allow the logging of transactions, capture of updates, and the ability to recover in the event of a systems failure. Data base systems provide the basis for ad hoc queries, while providing data independence at the data segment level. In general, the ability of a data base system to reduce the programming maintenance and increase the capability to respond to ad hoc query without the necessity of writing new applications programs results in increased programmer productivity.

We have discussed the necessity for benefit analysis and the technical side of data base systems and schools information systems. Let us put into perspective for a moment the role of technology and management in the development of an information system. Technology can provide potential benefits and their quantification. It can accumulate user input; determine technical feasibility; provide alternative solutions; and provide cost and schedules for delivery of application programs. It is the role of management to relate benefits to costs and schedule, and to provide cost justification, strategic value analysis and risk assessment to any development project. Merging these items, management can then set priorities, and in some cases determine that interim solutions are required for those development activities that are more long-range than others. One must be cognizant of the fact that in the absence of firm management direction in these areas, the decision making process will regress, such that development decisions are made by the technician, who is not concerned with these key management considerations.

The road to producing a school's information system is not an easy one. There are fundamentals plateaus that must be reached. These include information systems planning, specific systems definition, implementation strategy, data base design, and actual project implementation. A key plateau that must be accomplished is the training of the operational personnel who will run the system, and the user departments that will interface to it. Throughout these plateaus, management must recognize that a school's information systems is the property of the school district, not an individual user or the data processing department. As such, the development activity must be joint contribution of all user departments, data processing, and the executive management of the institution.

In conclusion, there are ten commandments for the successful implementation of an information system. These are:

1. Those who set policy are responsible for evaluation of goal attainment..

2. Information systems planning starts with executive perspective.

3. Information systems must be based on the needs of management and operational users, not conversely.

4. The information systems plan must be in step with the institution's long-range plan.

5. Information systems management system is more important than any component subsystem of the information systems plan.

6. Information systems are designed around processes, not organizations.

7. Function and performance must be tempered by justification and benefit analysis.

8. Data is an institutional resource.

9. No amount of tuning can compensate for poor design.

10. Information systems do not insure good decisions. Information systems assure that decision makers have good information.

A UNIVERSITY FINANCIAL MANAGEMENT SYSTEM

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ABSTRACT: Clemson University has recently developed a financial information system that serves as a focal point for all accounting, budgeting, and grant data. The system, which is designed along the NACUBO guidelines, records all accounting, budgeting, and grant data in a data base that is used to generate financial information in a batch and an on-line mode. The software design is such that the system can be transferred to other institutions having a different data base management system. Also, the techniques of modular design and structured programming are applied. This paper will describe the system from a financial management, as well as a data processing, perspective.

General Introduction to Clemson University

I believe it will be of interest to you to know more about Clemson University and believe that you may leave this session having a greater appreciation for our University and its role in higher education, including research and public service.

Clemson University is a South Carolina land-grant institution founded in 1889, the result of a bequest of land to the state by Thomas G. Clemson. Mr. Clemson was a scientist and agriculturalist who came to South Carolina from Pennsylvania in the 1830's and married the daughter of John C. Calhoun, a former statesman in South Carolina history and Vice President of the United States from 1825-32. Originally Clemson Agricultural College, the name was changed to Clemson University in 1964. Clemson is located in the northwest corner of South Carolina, near the borders of Georgia, North Carolina and Tennessee.

The main campus comprises 600 acres and represents an investment of approximately $87 million in permanent facilities. Nearly 80% of the University's main buildings have been constructed since 1950. In addition to the main campus there are approximately 32,000 acres of university farms, woodlands and camp areas for research in forestry, agriculture and 4-H work.

I. Overview of Budgeting, Accounting and Reporting

The system encompasses all financial requirements including budgeting for all types of funds whether federal appropriations, state appropriations, auxiliary enterprises, grants and contracts, loan funds, capital funds, etc. In addition it maintains all historical account data and facilitates all fiscal requirements including encumbrances and salary projections.

A. Financial data design

Clemson University has built its financial data base around one major system, the Accounting Information System. This portion of the presentation will focus primarily on this system.

The Accounting System conceptualizes and embraces the College and University Business Administration accounting principles. There are expansions to allow for the uniqueness of management and operational desirabilities at Clemson University, e.g., Clemson University has chosen to divide both the unrestricted and restricted current funds into additional sub-groups, as follows:

Unrestricted Current Funds - To account for the current funds which are determined to be within the definition of "Unrestricted," such as federal/state appropriations and general purpose operating revenues.

Unrestricted Current Funds - Auxiliary Enterprises - To account for separate self-supporting entities within the Unrestricted Current

Funds, with each having its own self-balancing assets, liabilities and fund balance.

Restricted Current Funds -
- Grants and Contracts
- Scholarships and
- Other

- To account separately for each of the above Restricted Current Funds sub-groups, with each having its own self-balancing assets, liabilities and fund balance.

Fund groups in addition to the current funds are:
- 6 - Loan Funds
- 7 - Endowment and Similar Funds
- 8 - Plant Funds
- 9 - Agency Funds

B. Accounting Information System

The System provides after the fact recording of all accounting transactions at Clemson University. The system accepts input directly from other automated systems (such as payroll or expenditure accounting) and from manually prepared transactions (such as journal vouchers or journal entries).

All input, whether manual or automated, is batched. Each batch is thoroughly edited, and any error within the batch causes the entire batch to be rejected. As batches are processed, the system generates automatic cash equity journal entries and postings to revenue and expenditure control accounts. In this fashion the system is kept in balance at all times.

The system provides complete audit trails of all transactions. A daily log is printed of all batches held on the error pending file and of all correct batches (including any appropriate automatic entries) posted to the data base or general ledger. The user may also request a selective audit of all the activity against a given account or group of accounts for a particular year.

When an error is detected within a batch for any accounting transactions, the entire batch is routed to the error pending file, and an error report is created. The accounting control section works with this report each day to prepare correcting entries and releases the corrected batches for re-entry (transaction type 30) in the next daily cycle. A batch which has an error remains on the error pending file and is repeatedly reported each day until it is removed or corrected.

The accounting data base contains all transactions that are entered into the accounting system. By reading field 2 - type of account - in the account number, these transactions can be separated into the three ledgers:
1. General Ledger
2. Revenue Ledger
3. Expenditure Ledger

The overview of the current fund expenditure account structure is shown in Exhibit I.

EXHIBIT I

Account Number Structure - Current Fund Expenditures

Key data elements

1	2	3	4	5	6
X	XX	XXXX	XXXX	XX	XXXX

Field 1 - 1 digit identifier - CURRENT FUNDS GROUP

1 - Unrestricted
2 - Unrestricted - Auxiliary Enterprises
3 - Restricted - Grant and Contracts
4 - Restricted - Scholarships and Fellowships
5 - Restricted - Other

Field 2 - 2 digit identifier - EXPENDITURE FUNCTIONAL CLASSIFICATION

20 - Instruction
30 - Research
31 - Research - Agricultural Experiment Station
35 - Extension and Public Service
36 - Extension and Public Service - Cooperative Agricultural Extension Service
37 - Extension and Public Service - Regulatory Service
40 - Academic Support
42 - Student Services
44 - Institutional Support
46 - Operation and Maintenance of Physical Plant
48 - Scholarships and Fellowships
60 - Auxiliary Enterprises

Field 3 - 4 digit identifier - OBJECT CLASSIFICATION OF EXPENDITURES

01XX - Personal Services - President
02XX - Personal Services - Classified Positions
11XX - Personal Services - Faculty and Staff
21XX - Personal Services - Graduate Assistants
31XX - Personal Services - Students and Other Temporary Help
32XX - Personal Services - Per Diem - Boards and Commissions
41XX - Personal Services - Fringe Benefits
51XX - Travel
61XX - Contractual Services
63XX - Postage, Supplies and Materials
65XX - Rents and Fixed Charges
71XX - Stipends, Scholarships, Fellowships and Grants-in-Aid
81XX - Equipment
82XX - Library Books
83XX - Permanent Improvements
91XX - Special Codes

Field 4 - 4 digit identifier - ORGANIZATIONAL UNITS
Major Intra-Organizational Unit (for sub-administrative, substitute entire 4 digit unit number)

03xx - College of Agricultural Sciences
05xx - College of Architecture
07xx - College of Education
09xx - College of Engineering
10xx - College of Forest and Recreation Resources
13xx - College of Industrial Management and Textile Science
15xx - College of Liberal Arts
17xx - College of Nursing
19xx - College of Sciences
28xx - Graduate School and University Research
29xx - Water Resources Research Institute
30xx - Libraries
40xx - Student Affairs
50xx - President's Office and Board of Trustees
51xx - Academic Affairs
53xx - Business and Finance
56xx - Development
59xx - Physical Plant
71xx - Athletics

Field 5 - 2 digit identifier - FUNDING SOURCE

Source of revenue from which expenditures are to be made
XX - Each Major Fund Group has codes unique within its group

Field 6 - 4 digit identifier
PROJECT OF DESCRIPTION, WHERE NECESSARY

0000 - A further identifier is not needed
0001 - Unique # to maintain individual project balance or other unique ident ty within a fund group

Shown below are just a few of the transactions.

Batch Type	Transaction Type	Transaction Description
02	Cash Recpts.	
	001	Student Payments
	002	Miscellaneous Receipts
04	Vend. Checks	
	010	Vendor Checks-Direct Vouchers Including Library, Purchase Orders
	011	Vendor Checks-Purchase Orders
	014	Vendor Checks-Voided
06	Payroll Cks	
	020	Payroll (Biweekly)
	022	Payroll (Voided Checks)
12	Journ. Vchrs	
	040	Motor Pool
	042	Central Stores
	045	Fringe Benefits
	046	Insurance
	049	Work for Departments (Routine Maintenance)
	050	Indirect Costs
	052	Telephone Services
	053	Bookstore Purchases
14	Journ. Entr. (Corrections to Account Numbers)	
	060	Receipts Corrections
	061	Payroll Corrections
	062	Vendor Corrections
	066	Journal Voucher Corrections
	067	Misc. Journal Entries (which may effect cash equity)
18	Journ. Entr. (Other Than Corrections)	
	080	Closing Entries
	081	Interfund Entries
	083	Reversing & Adjusting Entries
	084	Payroll Clearing Deposits
	089	Misc. Journal Entries

Other Update Transactions

Batch Type	Transaction Type	Transaction Description
30	Accounting Trans. Re-entry	
	101	Delete Entire Batch
	102	Add Transaction to a Batch
	103	Change Transaction Date
	104	Delete a Transaction
40	Account Key Changes	
	201	Add Key Entry
	202	Change Key Entry
	203	Delete Key Entry
42	Account No. Changes	
	251	Add single detail account No.
	252	Explode on field 3
	255	Change Detail Data
	256	Add Single Budget Account No.
44	Budget Amendments	
	301	Fiscal Year Beginning Budget-Expenditure Accounts
	302	Project Life Beginning Budget-Expenditure Accounts
	303	Fiscal Year Budget Amendment-Expenditure Accounts
	304	Project Life Budget Amendment-Expenditure Accounts
	305	Fiscal Year Beginning Budget-Revenue & Transfer Accounts
	306	Fiscal Year Budget Amendment-Revenue & Transfer Accounts
46	Project Award Information	
	401	Add External Project
	402	Change External Project
	403	Change Internal Project
	404	Delete Project
50	Encumbrance Changes	
	601	Add Encumbrance
	602	Change Encumbrance
	603	Delete Encumbrance

Automated Journal Entries are generated where necessary, except for batch type #18.

The daily processing system automatically generates three categories of cash journal entries and postings to the revenue and expenditure control accounts. These automatic entries and their appropriate transaction type codes are:

090 Posting to Revenue Control Accounts
091 Posting to Expenditure Control Accounts
092 Reduction of Vendor Account for Cash Disbursements
093 Recognition of Increase/Decrease in Cash Equity at State Tresurer Expense Clearing Account Level
094 Detail Distribution of Cash Equity at State Treasurer Level

C. Budget Maintenance Sub-System

The purpose of this sub-system is to provide a means to record and maintain the budget amounts for revenues, expenditures and transfers for a given fiscal period.

The budget information by account number is used primarily in preparation of the Budget Status Report for Expenditures and Realization of Revenue. A further use of the budget information and budget amendment transactions is to produce, as needed, summaries of budget information across categories of account numbers in order to provide more viable reporting and accounting.

Fiscal year beginning budget information is input the beginning of the year by way of an original budget entry document. Accounts that are established during a fiscal year have beginning budget data input at the time they are established. Budget amendments are input at any time during the fiscal year in the daily accounting cycle by way of a budget amendment document. A budget maintenance log and error report are provided for all budget transactions.

D. Provisional Design for Grants, Contracts and Other Restricted Funds

Special provisions are made for accounts where fiscal periods extend beyond or are other than Clemson University's fiscal year, primarily Grants and Contracts. Year-to-date budget and accounting changes at the detail level are shown on certain reports until project termination.

Information carried in the data base under those provisions are:

1. Project identification
2. Beginning and ending dates of the grant
3. Original direct and indirect award
4. Revised direct and indirect award
5. Cumulative expenditures for the fiscal and life period
6. Cumulative additions to fund balance
7. Cumulative deductions for overhead recovery
8. Computed revenue to the extent expended by source of revenue.

These data facilitate the preparation of annual reports for the restricted funds such as Statement of Current Restricted Revenues, Expenditures and Other Changes and the Statement of Changes in the Restricted Current Fund Balance.

The viability in these special provisions also allows for budgeting and report preparation over the life period of the accounts as well as budgeting and reporting restricted to the fiscal year period.

E. Encumbrances

Encumbrances are entered from purchase orders or other appropriate documents which may commit budget funds.

Encumbrances are relieved in the daily accounting cycle as postings are made to the account data base. Payments are coded either "Full" or "Partial," and are handled as follows:

1. Full Payment
   In this case the encumbrance is relieved in full, irrespective of the amount of the payment as noted in the payment transaction. The encumbrance no longer exists and will be physically removed from the data base.
2. Partial Payment
   A partial payment never totally relieves an encumbrance. The encumbered amount is reduced by the amount of the payment transaction. If the encumbered amount becomes less than zero, it is set to zero.

   A report is printed of those encumbrances that are zero. These can then be reviewed and modified through the encumbrance maintenance subsystem.

II. Data Processing

<u>System Overview</u>

In this section, the system will be reviewed from a data processing point of view. The discussion will begin with a statement of the system features. Next the system structure is presented followed by the data base structure. Finally, a summary of the structured programming techniques applied is given.

A. Design Features

1. The system produces all financial reports required by the University. The system creates audit, control report, and error/activity reports daily, status reports monthly, and financial reports at year end. In addition, certain reports may be requested at any time, such as account or project audit reports.

2. A mechanism is available for on-line inquiry as to the current status of an account, a grant, or an expenditure budget account group. These inquiries retrieve detail accounting transactions, budget amendments, and encumbrance transactions if extensive information is necessary.

3. The system is designed in a modular fashion and is coded in structured programming. All programs are written in a clear, straight-forward manner in ANS COBOL. The data base management system is IDMS, which is based upon the specifications of the CODASYL Data Base Task Group.

4. The particular data base access method used is not embedded into all modules. All data base access is done through called modules that retrieve or store records. The system is designed such that it can be transferred to other institutions having a similar application but possibly different data base software. The system does, however, presuppose the availability of some type of direct access.

5. A generalized report generator sub-system is used to produce all reports. Transactions requesting reports are maintained in a table within a program that sweeps the entire data base one time selecting all records needed for the requested reports. On-line inquiries, however, use direct access to the particular records of the data base which are needed.

B. System Structure

Daily. The recording of accounting, budgeting, encumbrances, and grant and contract award transactions is done on a daily basis. The batch types and transaction codes processed are shown in charts following Figure I. All input is batched and the two major sources of input are cards punched from source documents and files created by feeder systems such as payroll and accounts payable. These feeder systems generate batches of input that are input directly to the daily cycle. The system maintains all previously rejected accounting transaction batches on a pending file. Maintenance is done to this file to correct the previous errors and this file is processed each day along with the new input.

All of the daily sub-systems pass report records to a reporting sub-system which generates all reports at the end of daily processing. This reporting sub-system accepts a standard record format from each sub-system and references tables of error message descriptions, account number component descriptions, and a vendor data base in the process of generating the reports.

Monthly. The monthly cycle has two major functions. The first is to produce all monthly reports using the information in the data base. The second is to perform certain data base maintenance tasks. For example, all detail accounting transactions are rolled to the history file at the end of a month and total records are posted in the data base to summarize these transactions.

The monthly reporting sub-system employs the same report generator software used in the daily system. As a preliminary step, it builds a table of all monthly reports requested along with certain selection criteria and then passes the entire data base one time to select the needed records. The records are then processed by the report writer and the requested reports are written.

Yearly. The yearly cycle is similar to the monthly cycle in that it has a reporting function and a data base maintenance function. Yearly reports are generated using the generalized reporting sub-system which passes the entire data base and the history file of detail transactions. After it is determined that the accounting year can be closed, the final report generation is done and the year-end data base maintenance is done. While preparations are being made to close a year, it is possible to record transactions that reflect business of the next fiscal year as well as transactions of the year being closed.

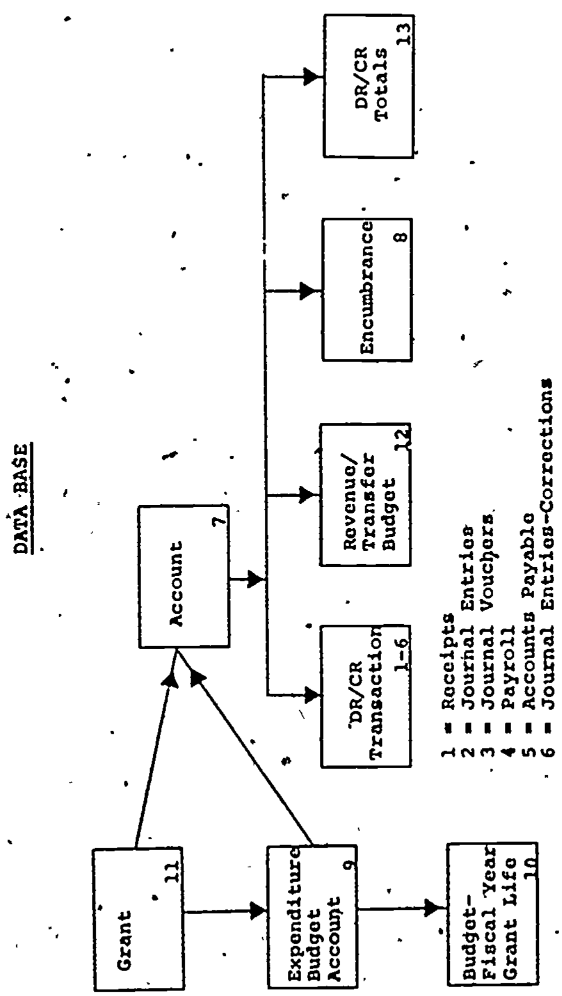
On-line Inquiry. The system supports on-line inquiry to the data base through the Time Sharing Option (TSO) of IBM 370/OS/VS. All data in the data base can be retrieved, but typically only account summary, budget status, or grant status data is obtained. A detail listing of accounting transactions, budget amendments, or encumbrance data can be obtained for an account or a group of accounts. The organization of the data base permits direct access at the grant, budget, and account number levels.

On-demand Reporting. The system can produce any of the daily, monthly or yearly reports out of cycle and can also produce user requested "one-time" reports through the generalized reporting sub-system. Special audit reports can be produced by submitting a report request transaction to the reporting sub-system. Records needed for a special report are extracted from the data base and/or history files according to the selection criteria and are then sorted and printed in the fashion requested by the user.

C. Data Base

A diagram of the data base is shown in Exhibit II. Direct access is provided to grant records (number 11), expenditure budget accounts (number 9), and detail accounts (number 7). Records under these record types are stored physically near their parent records. All the accounts in a given grant are members of a "set" and can be referenced directly, given the grant identification. Also, all expenditure budget accounts for a grant can be referenced in like manner, and all detail accounts for a given expenditure budget account are in a "set." The current status of a grant, for example, can be obtained from a terminal by entering the grant number and the level of information and then more detailed information for all types of accounts until his information needs are satisfied.

EXHIBIT II



D. Programming Approach

Several members of the systems development group have attended schools on and experimented with structured programming. Almost all members of the staff have experience in modular programming. It was determined that this project would be the first large development effort that would use those techniques associated with structured programming. The following techniques were employed:

Top-Down Design. Each major sub-system (such as budget maintenance) is broken down into smaller functions (such as read transaction, edit transaction, apply change update, generate report record, etc.). These functions in turn break into smaller functions (open file, call generalized date edit, etc.).

Highly Modular Design. Each module accomplishes usually one major task (edit account number, write accounting transaction, etc.). Each sub-system has a mainline module that drives the activity necessary by calling lower level modules, which may in turn call still other modules. The completed system has 350 modules. They are linked into 40 composite modules.

Mostly Structured Code. The basic constructs of structured programming were used with very few exceptions. It was discovered that, after orientation, programmers were able to read other programmer's code quite easily and were able to produce clear, readable modules in a very favorable time period. Also, maintenance of the system has proven easier than that of some of our more traditional systems.

Walk-Throughs. All programmers presented several of their modules in walk-through sessions. These served as an incentive for the programmer to write clear and easily-readable code and also served to catch many major errors before modules were unit tested. It was noted that the presence of higher level managers at the sessions tended to suppress participation and thus cause less real accomplishment.

Top-Down Implementation. Using this technique, testing of higher level modules was done before lower level modules were even coded. 'Stub' modules that displayed a trace code were inserted in composite modules so that calling modules could be tested.

Librarian. A project librarian was used to maintain all COBOL 'copy code' and to notify programmers of changes in this code during the design phase. Each programmer maintained the source modules that s/he was assigned by using the TSO Edit facility. At project implementation, all modules were put in a production library. These production modules are not changed by the programmer, but are replaced by the librarian when the programmer has tested a change using other libraries and the project leader has notified the librarian that the replacement should be made.

E. Manpower Requirements and Operational Characteristics

The general design of the system was completed in six calendar months, and the detail design, coding, and testing were done in about five calendar months of intense effort with a team of eight programmers. The total effort represented an investment of five programmer/analyst years and two manager years.

The daily portion of the system runs an average of four CPU minutes on an IBM 370/158. The elapsed time varies depending upon conditions from ten minutes to ninety minutes. The monthly data base reporting extract and maintenance requires about fifteen CPU minutes and runs about ninety minutes elapsed time.

The operational results of the system have been very good. All financial reports have been correct and in balance, and only four errors in production modules have been discovered to date. Also, the fact that the system is designed in a modular fashion has greatly facilitated the maintenance effort.

MIS -- PROBLEMS AND PROSPECTS FOR THE SCHOOL ADMINISTRATOR

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ABSTRACT: The concepts associated with Management Information Systems (MIS) have been generally accepted in a wide variety of organizational settings over the past two decades. The number of successful installations in business and industry, the military, government, education is surprisingly small. In any case, the burgeoning MIS literature shows that the aspiration to develop and implement MIS is widely held. Somewhat a latecomer to MIS, the nation's educational institutions are nonetheless finding that the presumed benefits are worth the effort. Such efforts are to be found in public and private educational institutions, large systems and small, in consortia, on a regional and as well on a state-wide basis. This presentation deals with the prospects for success in MIS in educational institutions. It will include a catalogue of constraints that need definition, understanding and amelioration if educational managers are to have available timely and accurate information for decision-making.

SCHOOL ADMINISTRATIVE CONTROL SYSTEM

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ABSTRACT: The School Administrative Control System (SACS) has been designed to provide administrative control information through efficient utilization of modern computerized techniques. The system operates on a mini-computer, using a data base management system. Areas of administrative control information provided, cover equipment inventory, budgeting, personnel, consumables inventory, purchasing and student activities funding. The various features of the system can be tailored to meet the requirements of a particular school district.

The School Administrative Control System has been designed to provide the necessary information for administrative control through efficient utilization of the most modern computerized techniques. In general, it uses data processing methods which have been well tested and proven in industry to reduce the risk to the School District. Implementation of this proposal will provide the timely and accurate information required to manage a school system in today's complex society in a cost effective manner.

The completed system is envisioned as being comprised of six main modules, implemented in seven phases. Each phase will be done so that there will be immediate benefits upon completion to School District, and also allow a go/no go decision to be made before beginning the next phase.

The system utilizes modern methods of data management, generally referred to as data base management system or DBMS. These methods insure improved data accuracy and enable future changes, especially those which are currently unable to be foreseen, to be made expeditiously.

The first phase will be to develop a general system design, covering all six modules of the total School Administrative Control System. The major effort during this phase will be the definition of the interfaces between each application module in sufficient detail so that an effective data base can be completed. A secondary objective will be to produce a detailed design for programming and implementation of the first scheduled application module.

A well executed general system design phase ensures that the completed product reflects the requirements of the ultimate user and provides for intelligent and orderly system module development and efficient data access to all application modules.

Another advantage of the general system design phase is that it also allows a more accurate estimate of costs and benefits to be made.

Many questions will be answered during the general system design phase to insure that the final system most reflects the needs of the School District.

For example, this phase should resolve the question of best mode of data entry for a particular application module; i.e. should the data be key punched and the module be run as a batch job, or should real time data entry be used with immediate processing of the transaction. It is anticipated that the methods of insuring data security and data integrity would also be developed at this time. Another point to be resolved during the general system design phase will be the reporting method requirements such as which reports should be terminal oriented to provide the users with the ability to describe exactly what information they desire to be produced from that specific run versus predefined reports that are routinely produced at some periodic time or on demand.

Figure I is a system flow chart of the School Administrative Control System showing the relationship between each module and the data base management system. The important point is that each application module has access to all the data and be able to read or modify the data as appropriate.

Figure II is a visual table of contents for the main system and each application module.

Figure III is the general file contents for the major files required to support the complete system. Some additional definition of the files will take place during the general system design phase. The first module installed should be able to provide visible demonstration of the soundness of the computerized administrative control philosophy quickly.

The Capital Equipment Inventory System is presently envisioned to contain the data necessary to define the location, condition and pertinent descriptive details of all equipment owned by the school system.

It would provide the ability to add new equipment to the system, modify the records about any particular piece, collect data for future administrative analysis, e.g. repair costs applied against a movie projector, and to delete records for scrapped equipment. The reporting capabilities would enable school administrators to quickly produce reports on the equipment assigned to each department, identify all equipment with a particular condition rating, summarize repair costs by type and brand, and access other information of administrative interest.

The Budget System is seen as having three major functions; a simple to use tool to assist in the development of the budget for the next budgetary period, the reporting of actual and obligatory expenses against a budget as they are incurred, and the ability to pull unanticipated requests from the data, i.e. a special report on a particular category of expense for each department (discipline). This module depends heavily upon the Personnel System and the Purchasing System to capture major segments of the data.

The ability to interactively develop a new budget has been used to great effect in industry and it should also provide similar benefits to school administrators as it allows them to rapidly cut and try a variety of methods of distributing the available funds without the manual labor and time generally associated with budget development. It also allows the rapid evaluation of the impact of arbitrary budget cuts or other modifications.

The budget development submodule will be very user oriented so that the method of developing a new budget can be learned very quickly by existing personnel, with only a minimum of knowledge of data processing.

The Consumables Inventory System would be linked to the Purchasing System to record the receipt of purchases, and to the Budget System to record the disbursement of stock to a particular department. If desired, the ability could also be included to monitor supply level and either automatically generate a purchase request or issue a warning when the stock level falls below a predetermined amount for any particular item. Stock Status reports would be produced routinely or on demand. In the latter instance, the requestor would have the ability to define the type and content of the report desired to satisfy his information requirements, and the system would produce them to specification.

The Personnel System would handle the routine processes of personnel records maintenance, paycheck generation, inputting payroll data to the Budget System, and the production of required periodic governmental reports. The payroll subsystem will be designed to have complete and thorough controls on the accuracy and security of the data. Furthermore, it will be able to handle the proper calculation of payroll deduction for those employees receiving multiple paychecks.

Some of the other possible applications, which will be investigated further, include the ability to develop teacher schedules, monitor the inventory of teacher training vs. classroom requirements and provide a tool for the evaluation of proposed contract modifications during negotiations.

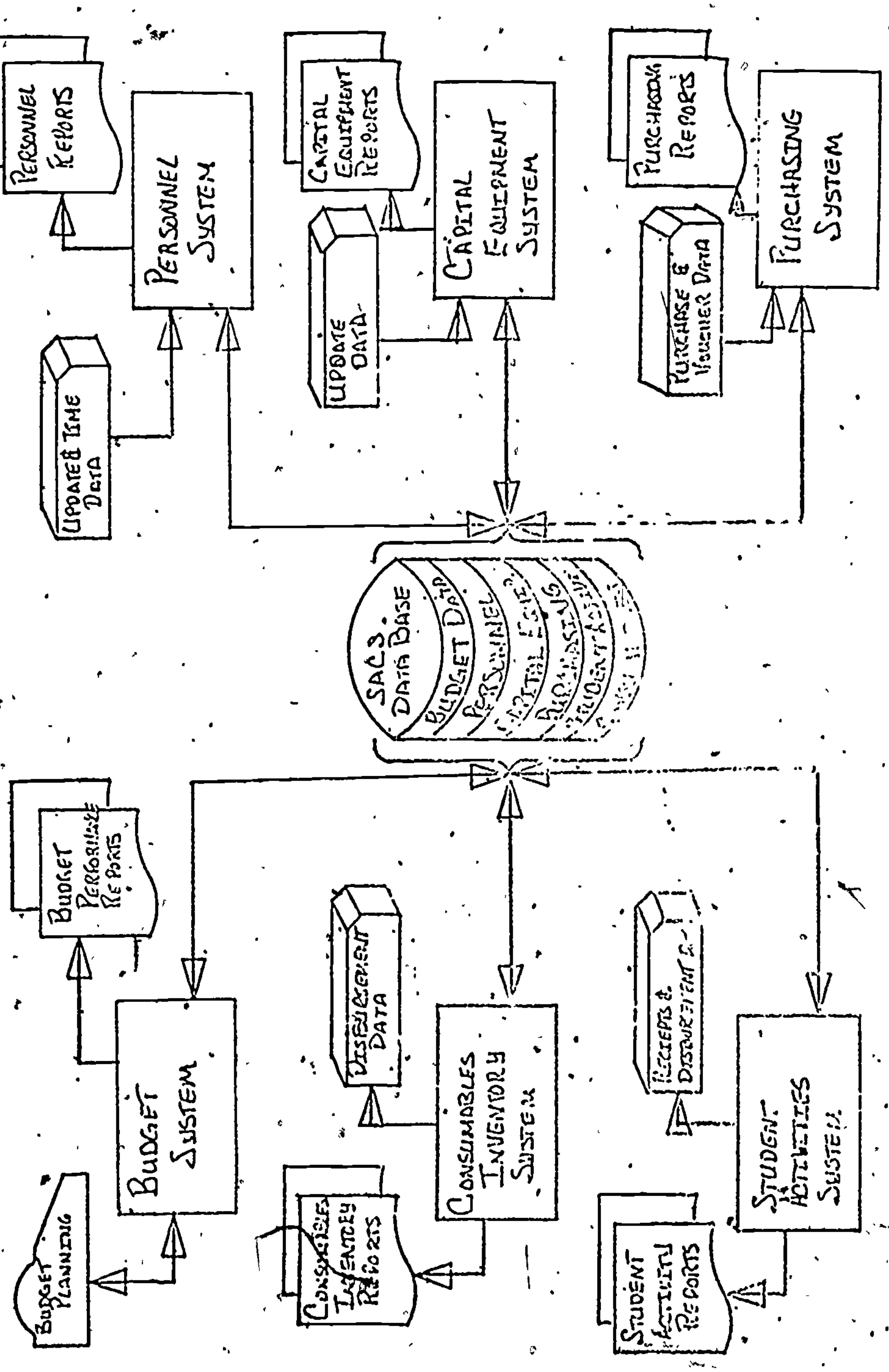
The latter could be implemented as a terminal oriented application to provide very rapid response during intensive bargaining sessions.

The Purchasing System will manage all data relating to purchase requests, purchase orders, receiving tickets, and vouchers. It is envisioned to handle all expenses except those relating to payroll.

During the processing of a purchase request, the purchase order, and receiving dock notification will be generated with the obligated funds 'tagged' in the proper budget account. When the material is received, the receiving dock notification will be processed to update the appropriate inventory files and prepare the system for vendor payment. After the vendor invoice has been approved, it will be processed to generate a check in payment and record the expense as actual ~~rather~~ than obligated. Allowance must be made, of course, for partial shipments and disputed invoices. The Purchasing System would also handle the purchase of services in much the same manner.

Various reports could be produced, routinely or on demand, to list unpaid bills, (roughly analogous to an accounts payable report), to provide information such as ordered date, vendor etc., unfilled purchase orders; and vendor performance reports to assist in determining which source provides the best service, the lowest cost, etc.

The Student Activity System will keep track of all funds raised or allocated to various student activities and the actual application of those funds. It is intended that a standard monthly report would be produced showing receipts, expenditures and balance by activity. As part of the receipt/disbursement processing, a check would be made to determine if sufficient funds existed to pay the expense. If not, a special report would be produced, and that activity marked so that additional expenditures could not be made without special authorization for processing.



School Administrative Control System — General System Layout

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Figure I

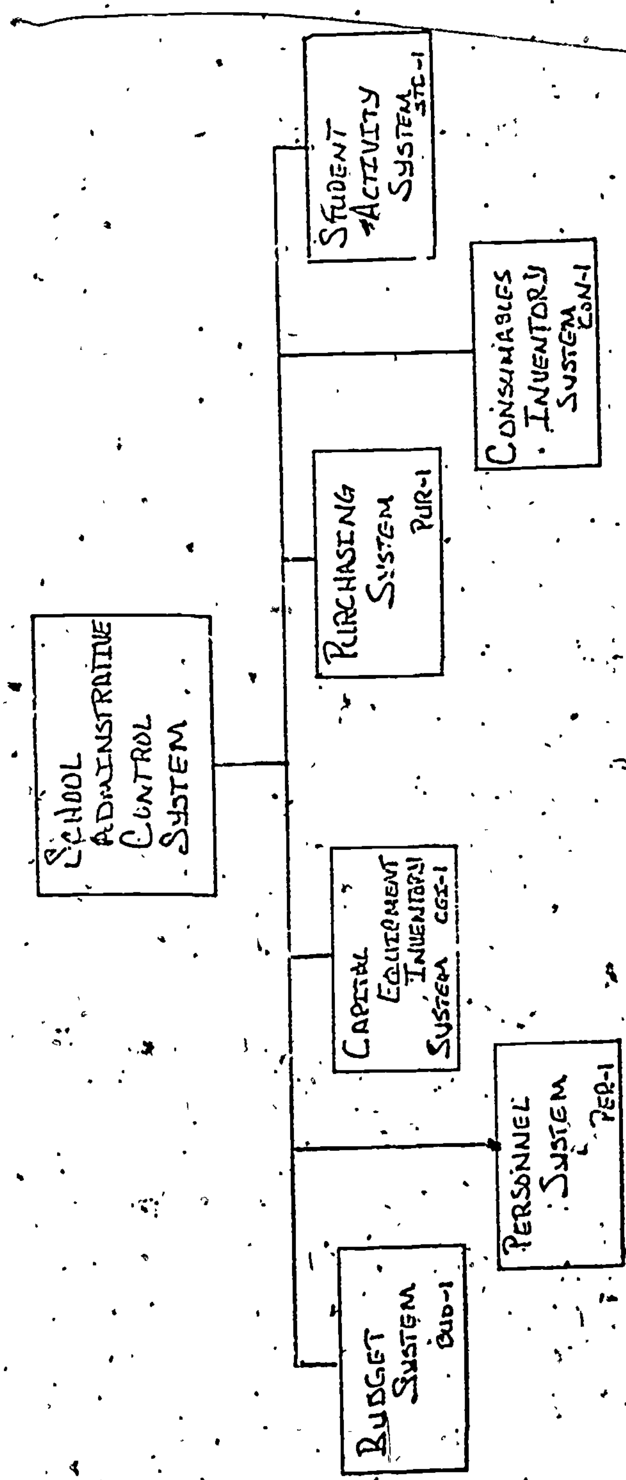
SCHOOL ADMINISTRATIVE CONTROL SYSTEM
STUDENT ACTIVITY SYSTEM STC-1
CONSUMABLES INVENTORY SYSTEM CON-1
PURCHASING SYSTEM PUR-1
CAPITAL EQUIPMENT INVENTORY SYSTEM CEI-1
PERSONNEL SYSTEM PER-1
BUDGET SYSTEM BUD-1

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Figure II

GENERAL FILE CONTENTS

I BUDGET FILE

A. SCHOOL OR GENERAL ADMINISTRATIVE CODE
B. DEPARTMENT
C. ACCOUNT
D. ANNUAL BUDGET
E. CURRENT MONTHS
   1. BUDGET
   2. ACTUAL EXPENSE
   3. OBLIGATORY EXPENSE

F. YEAR-TO-DATE
   1. BUDGET
   2. ACTUAL EXPENSE
   3. OBLIGATORY EXPENSE

G. ETC.

II PERSONNEL FILE

A. NAME OF EMPLOYEE
B. ADDRESS
C. TELEPHONE NUMBER
D. SOCIAL SECURITY NUMBER
E. DATE OF HIRE
F. TYPE OF EMPLOYEE (TEACHING/ADMINISTRATIVE/CUSTODIAL)
G. BENEFITS APPLICABLE
H. EXEMPTIONS
I. EDUCATION
J. CURRENT TEACHING LOAD
K. PAST COURSES TAUGHT
L. PAYMENT METHODS
M. RETIREMENT FUNDS DATA
N. WITHHOLDING TAX, SOCIAL SECURITY TAX PAID, ETC.
O. CURRENT STUDENT ACTIVITIES ASSIGNMENTS
P. PAST STUDENT ACTIVITIES ASSIGNMENTS
Q. MISC. ASSIGNMENTS
R. RACE
S. ETC.

III CAPITAL EQUIPMENT FILE

A. SERIAL NUMBER (PROPERTY RECORD NUMBER)
B. DESCRIPTION
C. CURRENT LOCATION
D. DATE PURCHASED
E. YEAR-TO-DATE REPAIR COSTS
F. LIFE-TO-DATE REPAIR COSTS
G. PRESENT CONDITION CODE
H. RESPONSIBLE DEPARTMENT
I. VENDOR
J. PURCHASE COST
K. ESTIMATED LIFE
L. BRAND
M. MODEL #
N. TYPE
O. REPAIR STATUS
P. ETC.

IV PURCHASING FILE

A. PURCHASE ORDER #
B. PURCHASE REQUEST #
C. VENDOR #
D. ITEM #
E. DESCRIPTION
F. PRICE
G. QUANTITY
H. COMMODITY CODE
I. MODEL #
J. EXPECTED DELIVERY DATE
K. ORDER DATE
L. TERMS
M. METHOD OF SHIPMENT
N. ORDERING DEPT.
O. AUTHORIZATION
P. PURCHASE TYPE (CAPITAL EQUIP. CONSUMABLES, SERVICE)
Q. VOUCHER #
R. RECEIPT TICKET #
S. ETC.

V VENDOR FILE

A. VENDOR #
B. VENDOR ADDRESS
C. ETC.

VI VOUCHER FILE (LINKED TO VENDOR & PURCHASE FILES)

A. VOUCHER #
B. VOUCHER DATE
C. VOUCHER AMOUNT
D. ETC.

VII STUDENT ACTIVITY FILE

A. ACTIVITY CODE
B. DESCRIPTION
C. RECEIPTS #
D. DISBURSEMENTS #
E. REC. DATES
F. DIS. DATES
G. STUDENT ADVISOR
H. ETC.

VIII CONSUMABLES INVENTORY FILE

A. ITEM
B. COMMODITY CODE
C. DESCRIPTION
D. PRICE HISTORY
E. ON HAND
F. ON ORDER
G. RESERVED ON ORDER
H. RESERVED ON HAND
I. BACK ORDER
J. MINIMUM STOCK LEVEL
K. EOQ
L. DEMAND HISTORY
M. MOST RECENT VENDOR
N. DISBURSEMENT #

IX VARIOUS MISC. SUPPORT FILES

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Figure III

A MULTI-DIMENSIONAL COMPUTERIZED PROGRAM BUDGETING AND ACCOUNTING SYSTEM FOR SCHOOL DISTRICTS

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Abstract: This paper will (1) present the design of a multi-dimensional computerized program budgeting and accounting system for school districts, and (2) discuss how the system can be effectively and efficiently utilized to assist in making policy decisions on resource allocation, and to facilitate budget preparation, budget review, account status reporting, and accurate financial control. Considered a simplified, workable and manageable version of a planning-programming-budgeting system (PPBS), this system generates eleven output budgeting reports and thirteen accounting reports, displayed in various formats and in different combinations of accountable units, programs and line-items.

A DATA BASE APPROACH TO PUPIL INFORMATION SYSTEMS

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ABSTRACT: The requirements for information about pupils in the public schools is continually increasing. These demands are being made by federal and state government agencies, by the local school systems, and by the individual schools. Most large school systems have used data processing techniques and computers to aid in the collection and reporting of such information, but often these systems can neither react to the timeliness nor the ever changing criteria of requests for information. However, with the advent of computer data base technology, the capability to better meet these requests does exist. Three years of operation have proven the data base approach to pupil information to be a successful solution.

INTRODUCTION

The school system of Baltimore County, Maryland has 167 schools serving a pupil population of approximately 125,000. In the early sixties the system followed the rather usual path of automatic processing of administrative data, i.e., the payroll, the other financial areas, pupil attendance, pupil standardized test scores, etc.

When the school system upgraded its processing equipment in the late sixties by changing to a third generation computer, increased capability became possible. Following a period of conversion of essential pupil accounting and information services, it became clear that a new approach would be needed if the school system was to realize more effective use of the equipment in the area of pupil information.

The basic pupil data file system that was in use at that time was a tape file which fundamentally had been designed to collect a summary of the attendance of each child on a monthly batch cycle. Since batch processing was the concept, the system required time each month for approximately 2000 entry and withdrawal transactions. After handling as high as 25,000 transactions at the beginning of each school year, it became clear that in addition to these initial delays, the file would be three to seven weeks out of date at any given point during the school year. (See Figure 1).

In addition to the basic pupil file in the "Pupil Attendance Summary System" (PASS), other sequential tape systems had been developed to process needed student information. Using the PASS as a starting point, each system would then "stand alone" with its duplicate data and its bank of processing programs, including file maintenance techniques, to do its assigned reporting task. (See Figure 2)

A third major concern was the need to have the capability to relate and process student information in three time categories--past history, current status, and future information. For example, pupils currently enrolled and attending classes in a high school must begin the process of course selection for the next year usually during the month of February. Therefore, registration data must be processed at least eight months in advance of the opening of school. It is clear that the pupil population currently enrolled and the population anticipated could be different.

These major concerns plus many smaller but critical concerns such as nonproductive tape sorting of large volume files, validity of the uniqueness of the pupil identification number in multiple files, inconsistancies with redundant data items in multiple files, and cross file information needs caused a serious examination of systems used to process pupil information.

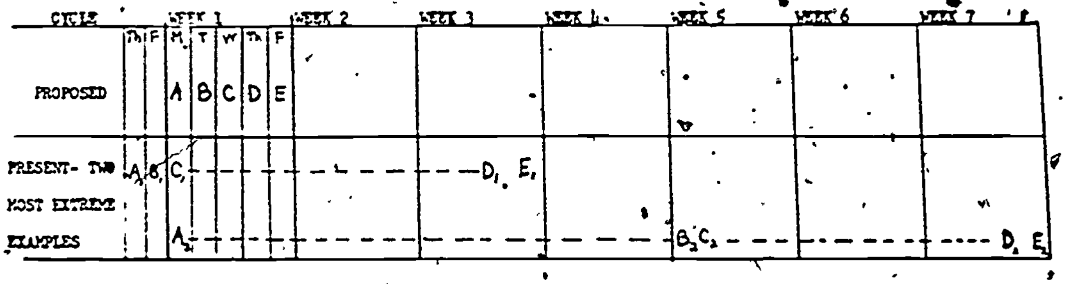
The development of the related systems, based upon the objectives, has proceeded at a rate of development which has allowed us to use available resources in an effective and efficient manner.

After three years of development, the following subsystems are in operation and producing information for the schools and other users:

Management Information Pupil Enrollment Subsystem
Management Information Pupil Address Subsystem
Management Information Student Attendance Subsystem
Management Information Student Scheduling Subsystem
(This system includes pupil report cards.)

Naturally, continued refinement and adjustments will be needed in our data subsystems as the information needs of the school system change.

FIGURE 1 AUTOMATED ENROLLMENT CYCLES



KEY: A - Enroll or withdraw a pupil at the school level

B - Send transactions to Child Accounting

C - C/A receives transactions and prepares input for Data Processing.

D - Transaction to automated file is complete

E - Verification is returned to the school

FIGURE 2

SYSTEM	ID NO.	SCHOOL	NAME	SEX	GRADE	RACE	BIRTHDATE	SECTION
PASS	X	X	X	X	X	X	X	X
DIPLOMA	X	X	X	X				X
ADDRESS	X	X	X	X	X			X
PUBLIC LAW	X	X	X	X	X		X	X
CLASS RANK	X	X	X		X			X
ROUGH SECTION	X	X	X	X	X			
REGISTRATION & SCHEDULING	X	X	X	X	X			X
STANDARD TESTS	X	X	X	X	X		X	X
TEST HISTORY	X		X				X	

BASIC SYSTEM OBJECTIVES

1. To collect and process pupil enrollment and withdrawal information daily.

2. To design a pupil information file that can be accessed randomly or sequentially, based on the unique pupil ID Number as a key.

3. To allow the existing PASS (Pupil Attendance Summary System) to be just that--a tape system to process attendance.

4. To provide random file maintenance of course selections and grades.

5. To provide random file maintenance to a school's master schedule.

6. To produce report cards and class lists, with grades, on a batch basis.

7. To provide analysis reports of pupil grades - later related to test scores.

8. To find class size by course and teacher. (number of course hours vs. number of pupils) on a batch basis.

9. To relate files to obtain cost per pupil, by subject and school, based on the associated teacher salaries.

10. To provide more accurate and timely information for organization and staffing projections.

11. To design this data base and the programs needed to create, maintain, and interrogate the files in such a way as to better serve our present needs and to allow for future expansion.

SYSTEMS DESIGN AND TECHNIQUES

By problem definition it was possible to define some general guidelines for systems design. The most critical need was a current and accurate pupil enrollment system. To accomplish that goal it was obvious that frequent updating, daily if possible, was needed. A second objective was the consolidation of files and the reduction of redundant data without reducing service to the users. Thoughts of some type of all encompassing large record system were immediately dismissed. Instead, a modular approach would be followed, building a system that could be added onto with a minimum of effort. The two objectives mentioned would be encompassed by the first module or "Phase I" of our pupil information system.

Design was limited by certain constraints. Whatever system we developed had to operate on our IBM 360/40 DOS computer. The computer had 256,000 bytes of core storage being used by three partitions. Finances dictated that teleprocessing could not be considered, nor could additional people in either the schools or the Office of Child Accounting. In Data Processing, we were limited to about fifty percent of the time of one systems analyst and one systems programmer, plus one, nearly full-time, programmer/analyst.

One position was already operative in the county was a daily pick up and delivery service between schools and central offices. We based our procedures on the daily collection of enrollment data that could be accomplished through this internal "mail" service.

To take advantage of this process, the schools had to adapt a "do it now" attitude. When a pupil enters, complete a registration form and send it to the Office of Child Accounting. The form would then be checked by the assigned clerk. If the pupil had been enrolled before, his previous identification number would be obtained from a microfilm viewer and recorded on the form. If not, the form would simply be passed on to keypunch, and when processed, the computer would assign the pupil an identification number. This would allow historical data to be retrieved via the pupil's ID Number, and for new pupils, the task of assigning unique ID Numbers would not be in the hands of the schools where problems had arisen before.

Labels would be printed with identifying data to be attached to the forms by the Child Accounting clerk. The forms would be returned to the schools to be stored in the pupil's office file. This process was estimated to take two to five days. If a pupil withdrew from the school, the same form would be pulled from the file. The school clerk would enter the withdrawal date and code, and he would again send the form to the central office for processing.

These were to be the basic procedures of the system. Then the question from a processing standpoint was what type of file structure could best facilitate the system? Daily sorting and maintenance of a tape system, for about 200 changes to a file of 130,000 pupils, was not feasible. The need for a random access system was obvious.

First consideration was given to a design using fixed-length segments with ISAM. Some basic problems were realized. One was the ability to access the data through different paths. With the increased emphasis on accountability, the need to link pupil files with personnel and financial data appeared to be a future demand. In addition to that primary limitation, there was also the ever-present synonym problem.

While following this basic line of thought, various ideas regarding pointer files and indexing were considered. It was at this time that we became aware of data base concepts and some of the data management systems that were available commercially. After a period of investigation, it was decided to try CINCOM's TOTAL, a data base management package that would operate in a DOS environment with COBOL as a host language. Indications were that TOTAL would help accomplish system objectives and save time as well. Without going into the details of our selection process, it is important to note that choices were limited by CORE requirements, DOS, and budget considerations. TOTAL met these limitations and at the same time offered the possibilities for modular development that were needed. One system did not justify the cost, but the ability to add on subsystems has proven the merit of our initial decision.

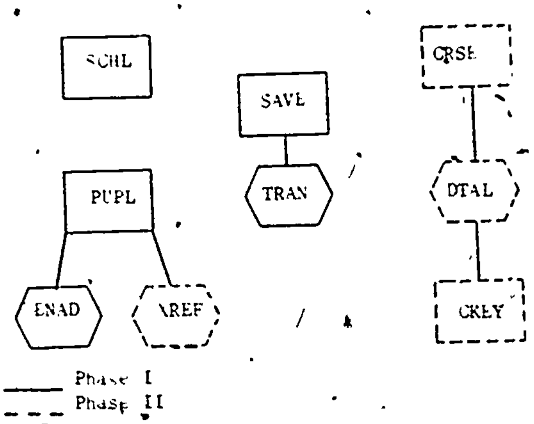
TOTAL is a network type of data base management system (DBMS) that allows the user to link data sets together with control keys. There are two types of data sets: master (single entry) files and variable (multiple entry) files.

Before designing a data base, it is very important that you have a clear definition of what you want to do, and to also have an understanding of the strengths and weaknesses of the DBMS that you are using. Random processing and inquiry from various entry points are definite assets, but sequential batch reporting can be a time consuming effort. The same is true of redundant data. Complete lack of redundancy sounds great, but in reality some duplicate data items may be advised for most efficient processing.

An analysis of pupil data items first exposed certain elements that are normally constant; pupil name, sex, race, birthdate, and identification number. These data were easily applied to a master single entry file (PUPL) with the identification number as a key. Other data are less stable; grade, test level, section, status, enrollment and withdrawal codes. In addition, a pupil may attend more than one school during the school year. Enrollment data was, therefore, placed on a variable file linked to PUPL with one segment per school attended. A coded address segment was also carried on this file (ENAD). Figure 3 is a picture of the data base structure.

A second variable file for courses and grades was planned for, but not included in Phase I. A blank linkage field from PUPL to this file was included in the data base generation.

FIGURE 3



A master school file (SCHL) was also included in the design. Our initial thinking would have linked this file to the ENAD variable file, but further analysis indicated the weakness of that idea. Linked variable records would have been located at such a wide span of addresses that entry from the SCHL file would have been very inefficient. Secondly, the need to access enrollment data by a single school did not really exist. Most requests were asking for all schools or groups of schools, which would have been better handled by our batch reporting techniques.

Batch reporting was accomplished by serially sweeping the ENAD file and, if PUPL data was needed, matching the resulting tape to a serial sweep of the PUPL file. In addition to reports, microfilm was then produced via COM (Computer Output Microfilm) for access by the Child Accounting clerks.

Attendance was handled in a similar fashion; by extracting required data, collecting attendance, and then loading year-to-date figures back onto the data base. Current month or two-month attendance figures were reported directly from the batch/tape attendance subsystem.

All file maintenance of the Phase I data base was designed to be processed by one program. A batch version of the same program handled any large volumes of changes. This gave us a very tight control of the data.

The daily version of the file maintenance program wrote all successful transactions onto a master and variable file (SAVE and TRAN). The last pupil ID Number assigned was stored on the master file at the end of each file maintenance run. The next run would then pick up with that number and add one to continue assigning unique ID Numbers. A print program, run as part of the file maintenance job stream, would sort and print these transactions by school. A label program would print labels from the same file for all new entries. The total process ran in five to ten minutes.

Another advantage of this daily updating has been the leveling of keypunch volume. Operations would much rather process two hundred transactions daily than thousands at the end of each month.

Phase II of the data base involved the addition of pupil course offerings, selections, grades, and school master schedules. A file to carry courses and grades by pupil was linked to the PUPL file (XREF). In addition, three new files were generated to carry school schedule and course data (See Figure 3). The original Phase I file maintenance program was expanded to handle pupil course/section and grade changes. A separate program was written to maintain the three additional files.

The IBM S 360 scheduling package and a pilot grade reporting system were in operation. With the implementation of Phase II of the data base, the use of these systems continued, but instead of being self-maintained, they simply loaded data onto, and extracted data from, the data base. This allowed the daily file maintenance necessary to insure accuracy.

The expansion of the original data base to include Phase II files was handled with a minimum of effort. This was partly due to certain features of TOTAL that allow for change. It was also in part due to programming techniques such as cataloging file descriptions and the development of subroutines to handle repetitive type functions. And looking to the future, adding additional data items, or files, to the system does not present itself as a fearful task.

A GEOGRAPHIC ANALYSIS SYSTEM FOR STUDYING SCHOOL ATTENDANCE BOUNDARIES

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ABSTRACT: The Geographic Analysis System developed and used by Denver Public Schools during the past two years is a practical method for collecting, maintaining, and utilizing geocoded student addresses. Using contracted services, the center of each block was digitized with X and Y-coordinates. Merging the digitized data with the city's locator file an address coding guide file was built containing coordinates for each street segment within the district. The ACG file provides a means of assigning coordinates to each student's address.

The system integrates demographic data from the student database, the ACG file, and an attendance boundary file to produce population distributions, student listings, block counts, and busing eligibility listings for each of the district's 130 elementary school areas, 35 junior high areas, and 18 senior high areas. The system will also produce a school assignment directory, identify students who illegally cross attendance boundaries or reside outside the school district, and automatically transfer students residing in a specified geographic area from one school to another.

INTRODUCTION

Over the past several years, there have been numerous efforts by school districts across the country to utilize the computer in the process of planning school attendance boundaries. The purpose of this paper is to describe a computerized system, developed and utilized by Denver Public Schools, to assist in the planning of school attendance boundaries. The Geographic Analysis System consists of the collection and maintenance of geocoded address data, the process of utilizing this data for preliminary boundary planning, the analysis of geocoded addresses and demographic data for making planning decisions, and a linear programming student assignment model for reassigning students between racially imbalanced schools.

The system study began in October, 1973, and was implemented by March, 1974. The objective in developing the system was to respond to extensive or minor attendance boundary changes quickly and accurately. Prior to the development of the geographic analysis system, the school district used the traditional "pin map" method. This method is obviously slow in responding to extensive boundary changes.

Although a computerized attendance boundary planning system had been discussed by the administration in earlier years, a system had not been developed, probably due to the lack of a significant need. However, the school district, as the defendant in a desegregation case since 1969, realized that a court order to desegregate the school system was forthcoming. The decision to desegregate the entire school district was handed down by the U.S. District Court in December, 1973. It required that when school opened in September, 1974, each school have between 40% and 70% anglo enrollment. Therefore, the first utilization of the geographic analysis system was to assist the planners in the development of attendance boundaries which effected the reassignment of 35,000 of the district's 83,000 students. This would have been a horrendous task using the "pin map" method. The system has been used since then to study and plan changes required by population shifts and recent decisions from the appellate court.

THE ADDRESS CODING GUIDE

Preliminary research indicated that a critical need for continued use of a geographic analysis system is an address coding guide (ACG) file, which contains the necessary data for translating an address into an ordered pair of numbers (e.g. X and Y-coordinates). Based on attendance boundary policies, it was decided that it was only necessary to have coordinates for the center of each block. Using the ACG file, each student's address, which was already a part of the pupil database, could be appended with the coordinates of the block's center. Similarly, the vertices of each school's attendance boundary could be expressed in terms of the same coordinate system and an identification of the students who live within a specified area could be made by an area analysis program. In fact, all the areas for a given school level could be analyzed in one pass of the pupil database.

In search for the data to build our ACG file, we started with the Denver Regional Council of Governments (DRCOG). We were already aware that DRCOG had obtained from the U.S. Census Bureau a geographic base file used for the 1970 census. The Dual Independent Map Encoding (DIME) file will be used again by the Census Bureau in 1980. It is the responsibility of DRCOG to maintain the DIME file during this period. However, we were informed by DRCOG that the DIME file had not yet been maintained since the 1970 census and did not contain coordinates. We were then referred to the City of Denver Data Processing Services. The city had acquired the DIME file after the 1970 census to build a locator file. Although the city had not added coordinate data, they had maintained the locator file.

After obtaining a tape of the city's locator file, we built our ACG file. The ACG file contained a record for each side of each block (54,000 records). Initially, each record contained the following elements:

ELEMENT	EXAMPLE
Street name	Broadway
Indicator code (e.g. Avenue, Street, etc.)	Avenue
Direction (e.g. N,S,E,W)	S
Side (e.g. E for even, O for odd	O
Highest address within the block	1099
Lowest address within the block	1001
Census tract number	16.01
Block number within the census tract	236
Zip code	80209

To complete the ACG file, we had to add the X and Y block coordinates.

In the City of Denver, there are approximately 8000 unique census tract/block number combinations. Since coordinates were to be measured for the center of each block, 8000 points had to be digitized.

There are several companies in Denver who use machines to digitize points on a map. The digitized data can be output to either punch cards or magnetic tape. After discussing our problem with these companies, it was decided that we would purchase a set of quarter section maps from the City Engineering Office. We would code the census tracts and block numbers taken from the 1970 Census Bureau Metropolitan Map Series onto the quarter section maps. In the process of digitizing the visual center of each block from the quarter section maps, a card containing the census tract, block number, and the X and Y block coordinates was punched by the digitizer machine for each of the 8000 block centers. The coordinate system selected for digitizing was the state plane coordinate system. This coordinate system was chosen because the Census Bureau Dime file record layout provided space for the state plane coordinates for the beginning and ending points of each street segment.

Since the census tracts and block numbers on the Metropolitan Map Series matched our ACG file, all that remained to complete the ACG file was a simple update program to process the 8000 cards against the corresponding ACG records and add the coordinates to each record. This was followed by updating each student's address record with the appropriate block coordinates from the ACG file; thus, creating student address coordinates. Also, changes to the pupil database maintenance program were made to validate addresses of new student registrations and address changes as they occur. If the validation of the student's address against the ACG file is successful, then the address coordinates are inserted in the pupil's address record. Therefore, reports always reflect the most current geocoded addresses.

Once each year we purchase from the City Engineering Office a copy of the quarter section maps which had been updated during the previous year. This usually consists of blocks cut out in new development areas. The ACG file is appropriately updated at that time and at any other time to correct errors.

ATTENDANCE BOUNDARIES

The attendance area boundaries must be defined using the same coordinate system used in digitizing the block centers. Since the school district maintains a policy of not splitting a block by an attendance boundary, attendance boundaries will coincide with streets, highways, or rivers. The attendance boundaries are defined by the coordinates of the vertices and the coordinates of significant points along a curved street. The vertices must be sequenced in a clockwise direction. This is required by the routine which analyzes the student's address coordinates against the coordinates of the attendance areas to determine the attendance area in which a student resides.

The coordinates for the attendance area

vertices are measured by overlaying a transparent grid over the appropriate quarter section map. The coordinates of the point are relative to the coordinates of any one of the corners from the quarter section map. Since each side of a quarter section is one half mile in length, the coordinates for each corner of the 420 quarter sections can easily be predetermined.

The attendance area number, the vertex number, the X and Y-coordinates of the vertex, and the names of the two streets which intersect at the vertex are recorded. When this data is complete, it is inserted into an attendance boundary file to be used by applications requiring a numeric description of the attendance area boundaries. The attendance boundary file contains approximately 2800 records for 183 attendance areas.

Although the procedure for measuring the vertice coordinates is somewhat tedious, not every point has to be measured. Adjacent attendance areas will have the same vertices and consequently the same coordinates. When the Census Bureau's DIME file has been brought up-to-date and contains geographic coordinates, this procedure can be easily automated, since the data in the DIME file will contain the coordinates of the same points we use for boundary vertices.

APPLICATIONS

One of the boundary planning tools of the system is the grid printout, which is most useful during preliminary planning stages. The grid printout consists of dividing an area (e.g. the entire city) into square cells of a specified size. For each cell the number of students who match the specified parameters (e.g. grade level range and ethnicity) is printed. A grid is superimposed over a district map and the numbers in the corresponding cells are transferred to the map. For our purposes, each cell was specified to be approximately 2000 feet long on each side and typically includes 18 blocks. However, the size of the cell may be modified to suit the particular need.

After the transfer of data to the maps has been completed, the planner can begin constructing the boundaries using whatever guidelines are pertinent. At this point, the boundary lines are constructed by the planner along the grid lines and in many cases blocks are split. Therefore, after this preliminary process is completed, the boundaries are adjusted to the nearest streets. Other refinements to the boundaries may also be made, such as moving boundaries to coincide with nearby highways, rivers, and other natural hazards.

The grid data is particularly advantageous for the planner at this stage because it is less voluminous than the block count data previously available from the "pin map" method. The grid data can be used in conjunction with other data to generate a trend surface map of some demographic or educational characteristics on a digital plotter. For example, trend surface maps may be generated indicating the percent of anglo students, achievement test scores, or incidence of welfare recipients.

The next step in the planning process is to measure the coordinates of the vertices for each attendance boundary. This is followed by an edit procedure to assure that adjacent school boundaries do not overlap or have a gap between them.

After correcting the boundaries, a report of the population distribution in each attendance area is printed and a summary of the number of students by grade level and ethnic code in each block within each attendance area is printed. The planners review the population distribution reports for each attendance area to ascertain whether the planning guidelines in terms of the school capacity, ethnic distribution, and grade level distributions have been achieved. When it is determined that an attendance area does not meet the guidelines, the planners will analyze the block counts to decide where boundary adjustments can be made between adjacent areas. This is an iterative process. However, after several iterations, there may still exist some undesirable attendance area distributions which the planner can't resolve. In our case, the undesirable attendance areas are predominately anglo or predominately minority. Therefore, the next step is to employ a linear programming student assignment model. The purpose of the student assignment model is to identify the number of students to be reassigned between racially opposite schools to achieve racial balance and minimize the total distance traveled by all students who must be reassigned. The student assignment model is based on the classic linear programming transportation model designed to minimize transportation costs.

A linear programming model may have various constraints such as grade level, sex, school capacity, ethnic data, or other pertinent characteristics. However, if the constraints are too restrictive or the constraints are conflicting, then it will be impossible for the model to produce a feasible solution. When this occurs, the planner must relax or eliminate one or more of the constraints.

Another consideration in setting up a linear programming model is the capacity of the computer. A linear programming model can easily exceed the capacity of a computer if the number of decision variables and the number of constraints are not contained within reasonable limits. For example, to use a linear programming assignment model to assign students from each of the city's 8000 blocks to each of the district's 91 elementary schools would require a model with 728,000 decision variables; far exceeding the main memory capacity of the computer. Furthermore, the running time for such a large model would be prohibitive.

After the attendance boundary plan is adopted, a report listing the students alphabetically within grade level for each attendance area is printed. A copy of this report is sent to the school which the area is assigned, and a copy is sent to each school indicating the students enrolled in their school who are being assigned to a new school. Also, at this time, a projected transfer file (PTF) is built. The PTF file identifies all students who will transfer to a new school at the beginning of the next school term. The file is the controlling file used to transfer students on the database to their newly assigned school.

The school district has a policy that any student who lives more than one mile from the elementary school, two miles from the junior high school, or three miles from the senior high school to which he is assigned, is eligible to be bused by the school district. Therefore, after the attendance boundaries have been adopted, a report of the students and the number of students by block who are eligible for district transportation is printed. The transportation department uses this data to determine their busing needs and to plan the bus routes.

Also, at this time, a directory of school assignments by block ranges is printed. This is done by analyzing the records in the ACG file against all the attendance boundaries. The directory is a summarized reference for answering questions concerning the schools a student should attend when given an address. Prior to the existence of the AGG file, the directory of school assignments would have been very impractical to produce. Questions concerning which elementary, junior, and senior high schools a student should attend when given his address required someone to accurately read three large maps.

After the schools have opened, a report of the schools who have students enrolled who do not live within the school's attendance boundary is printed. Unless the student has approval to attend the school, he is transferred back to the school to which he was assigned by the adopted attendance boundary plan. Also, at this same time, students attending a Denver Public School who do not live within the district are identified. These students are required to pay tuition.

THE ANALYSIS ROUTINE

To determine if a student lives within a specified area, the attendance area must be considered as a closed polygon defined by the vertice coordinates, and the student's residence must be considered as a point defined by the address coordinates. The determination of whether the student resides within a specified attendance area is equivalent to determining if a point lies within a polygon.

The point-in-polygon (PIP) routine is based on a simple geometric fact. Given a polygon with no horizontal sides, if a point lies within the polgyon, then a horizontal line through the point of consideration will intersect an even number of polygon sides and the X-coordinate of the point will be greater than an odd number of the X-coordinates of the points of intersection made by the horizontal line and the sides of the polygon. To eliminate horizontal sides of the polygon, one of the Y-coordinates of the boundary are adjusted by one foot whenever two successive points have the same Y-coordinates. This will not effect the accuracy of the results. To illustrate this fact, refer to Figure 1.

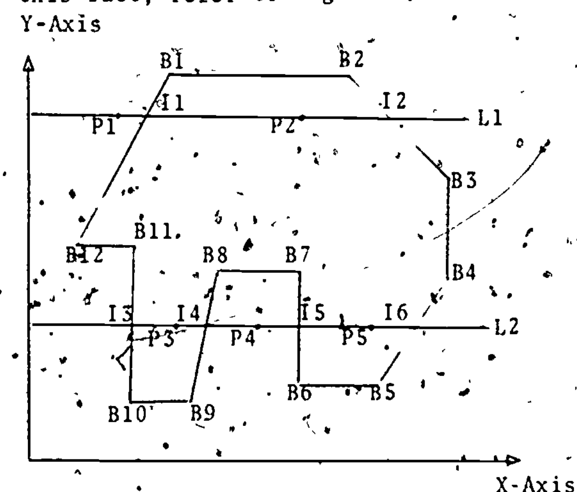

Figure 1

In Figure 1, the attendance area boundary is defined by the vertices B1, B2, ..., B12. In determining the location of P1 and P2 relative to the polygon, note that line L1 intersects two polygon sides--B2B3 and B12B1. Since the X-coordinates of P1 are not greater than I1 or I2, P1 lies outside the polygon. On the other hand, since the X-coordinates of P2 are greater than I1 and less than I2, P2 lies within the polygon. A close examination of the points P3, P4, and P5 will prove to be consistent with this fact. P3 is greater than I3 and lies within the polygon; P4 is greater than I3 and I4 and, therefore, lies outside the polygon; P5 is greater than I3, I4, and I5 and, therefore, lies within the polygon. Of course, if the coordinates of the intersection point are the same as the point being analyzed, then the point being analyzed lies on the polygon.

See Appendix A for a more detailed description of the PIP routine.

FUTURE ENHANCEMENTS

The following items are some system enhancements which may be added in the future:

(1) To facilitate quicker response to boundary studies and changes, develop an automated system for determining the vertex coordinates of new boundaries. This requires an up-to-date DIME file with coordinates.

(2) Develop a simulation model for boundary planning to replace the manual process of working with the grid data.

(3) Develop a simulation model for bus assignments and routing.

Each of the latter two enhancements require the DIME file and traffic network data such as one way streets, dead ends, dividers, bridges, speed limits, stop lights, stop signs, and other traffic controls and restrictions. This type of computer data does not exist at this time. However, as the need increases for traffic network data by the city fire and police departments, it will be developed.

(4) Plot attendance boundaries using computer boundary data and a digital plotting machine. The boundaries can be plotted on the same scale as the school district map; so the boundary plots can be superimposed over the map.

(5) Geographic and ethnic trend analysis of student withdrawals, entries, suspensions, test scores, and other demographic data.

(6) Online inquiry to answer the "what if" type questions pertaining to planning of boundary or facility changes.

APPENDIX A

POINT IN POLYGON ROUTINE

A. Build a table of the vertice coordinates for all boundaries to be studied. After inserting the coordinates of the last point for each boundary in the table, repeat the coordinates of the first point. This is necessary to facilitate a smooth flow of the polygon segment analysis performed by the analysis algorithm. As the vertice coordinate table is being built, if any two successive points for the same boundary have the same Y-coordinate, then either add 1 or subtract 1 from the second Y-coordinate so as to include the boundary segment as originally defined. Also, as the vertice coordinate table is being built, setup a corresponding table of the minimum and maximum X and Y vertice coordinates for each polygon. The minimum and maximum X and Y vertice coordinates define the rectangle which contains the corresponding polygon. Since it is true that a point lying outside the rectangle will also lie outside the enclosed polygon, the PIP routine can more quickly determine if a point should be further analyzed by comparing the relationship between the X and Y address coordinates against the minimum and maximum X and Y vertice coordinates.

B. The PIP routine analyzes each set of address coordinates passed to it against the vertice coordinates table for all boundaries. After analyzing the address coordinates against all the boundaries, a status table is passed back to the calling routine indicating in which area(s) the point was located. The PIP analysis is illustrated in the following decision table.

DEFINITIONS:

X,Y = Pupil address coordinates to be analyzed.

I = Subscript indicating the polygon segment being analyzed.

J = Subscript indicating the polygon being analyzed.

X(I),Y(I) = Vertice coordinates of the beginning point of the polygon segment being analyzed.

X(I+1),Y(I+1) = Vertice coordinates of the ending point of the polygon segment being analyzed.

XMIN(J),XMAX(J), = Coordinates of the
YMIN(J),YMAX(J) rectangle containing the polygon being analyzed.

PX = X-coordinate of the point of intersection of the polygon segment and the horizontal line passing through the point being analyzed.

K = Indicates the relative location in the vertice coordinate table of the polygon being analyzed. Set K to zero prior to analyzing each pupil address coordinate.

DECISION TABLE FOR PIP

ACTION	YES	NO
1. Increment J from 1 by 1. Is J > number of polygons being analyzed?	13	2
2. Set IPIP = 0.	3	3
3. Increment I from 1 by 1. Is I > number of sides of the polygon being analyzed?	9	4
4. Is X > XMAX(J) or X < XMIN(J) or Y > YMAX(J) or Y < YMIN(J)?	12	5
5. Is Y ≥ Y(I) and Y < (I+1) or Y ≥ Y(I+1) and Y < Y(I)?	6	3
6. Compute $PX = X(K+I) + \frac{(Y - Y(K+I))(X(K+I+1) - X(K+I))}{Y(K+I+1) - Y(K+I)}$ Is PX > X?	3	7
7. Is PX < X?	8	11
8. Set IPIP = IPIP + 1.	3	3
9. Is IPIP an odd integer?	10	12
10. Set PIP-STATUS(J) = 1. (The point being analyzed lies within the Jth polygon.)	1	1
11. Set PIP-STATUS(J) = 2. (The point being analyzed lies on the Jth polygon.)	1	1
12. Set PIP-STATUS(J) = 3. (The point being analyzed lies outside the Jth polygon.)	1	1
13. Return to the calling program.	-	-

CINCH An Attendance System for Small Time-sharing Systems

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ABSTRACT

CINCH is a Management Information System for student attendance information developed to operate on a computer used mainly for instruction. The system is written in BASIC. The data base for the system consists of course information, student information and attendance/grading information. The uses include reports to parents, teachers, counselors and deans as well as reports generated for state required Average Daily Attendance figures. The economies of operating on a small computer used mainly for instruction mean that both the administrative uses and the instructional uses of the system are easily affordable.

INTRODUCTION

CINCH is a model management information system designed to provide school administrators with a wealth of easily handled data based on student attendance and performance.

The main purpose of the CINCH system is to provide easily maintained and extensive data on student attendance patterns. From its inception the main purpose of CINCH has been to provide parents with an individual record of their students' school performance. Because of the detail of the data needed to provide these periodic reports to the home, several kinds of information are also available to the school.

A secondary goal of the CINCH effort is to provide a model for how small computers, primarily used for instruction, can be used for meaningful administrative purposes. Computer Assisted Instruction and Computer Support of Instructional Activities are extremely important uses of small, general purpose digital computers. If, however, instructional use does not exhaust available computer capacity, it is economically desireable to provide administrative services to the school community. CINCH is intended to provide a model of such a use — a model that encourages open communication, community participation, vocational education and opportunities for outside funding.

Brief History

CINCH was developed at the request of one of the Senior High School principals in the San Francisco Unified School District. Among other requests, he wanted to send periodic progress reports home to the parents and wondered if the small timesharing system then in use for instruction could aid in achieving that goal. There was also a desire to monitor the overall attendance pattern in the school since absenteeism tended to be quite high and to fluxuate markedly.

The staff of the EDP Resource Center had been discussing various ways in which the computer (then a Hewlett-Packard 2000B system) could be used for administrative purposes in order to fully utilize it's potential and this suggested application seemed an ideal opportunity.

During the first year (1971-72) of the project more was learned, perhaps, than was produced. The machine available was a Hewlett-Packard 2000B Timesharing System. It was more limited in size and capabilities than the HP-2000F presently in use but it was "big enough." A system was designed to meet the main requirement of producing reports for parents. As the system started operation, the administration of the school began to appreciate the potential and formulated additional uses for the available information.

The learning experience of the first year provided a firm idea of the kinds of data that could be maintained and reported to the school community. We also gained a better idea of the operational constraints on the system and the kinds of learning opportunities which can be provided to students by the existence of a system that has real parallels in the business community

Several extensions were made for the second (1972-73) year of operation. These extensions included a new method for feeding the attendance information into the computer system. Rather than lists to be filled out at the end of each reporting period then entered from a keyboard into the computer, the information was recorded on "mark sense" cards and entered automatically into the computer through an optical card reader.

Recording the information on cards means that it could be entered into the machine directly, eliminating the keyboard entry step This "batch" method meant more detailed attendance data could be recorded directly by the teacher and entered into the computer rapidly without reducing the instructional use of the system by so much as one terminal. Entering the data directly from teacher-marked documents also meant that time formerly spent in inputing the data could be spent in earlier verification of the information and final reports could be available quite rapidly.

A modification in the type of information reported was also made during the second year. Since a card was available for each student in each class, daily absence and tardy indications were recorded for each student with the approximate grade (as before) marked at the end of the card. Daily marks for tardies and absences dramatically extended the depth of the information available within each reporting period.

The data retained for each student was expanded. The following information was retained in the system for each student:

1. Student Name
2. Sex, Grade, Counselor, Homeroom
3. Course Sequence Numbers
4. Cumulative Absence and Tardy figures for the semester
5. Tardy and Absence figures for the reporting period
6. Approximate grade for the reporting period
7. Home address for each student

The third year (1973-74) refined the operation of the system. Some new reporting functions were added and in general, the system became a routine part of the procedure of the school At the same time the school district's central office used many of the features of CINCH in designing the district wide system.

DESCRIPTION OF CINCH

The CINCH system consists of several programs written in the BASIC language and operating on the Hewlett-Packard 2000 series Time Shared BASIC (TSB) system. The programs are of three main types:

Data maintenance
Reports
Statistics

In addition, several utility programs were developed for handling house-keeping chores such as alphabetizing student names, consistency checking of the data, bulk updating of file information, etc.

Data Maintenance

Data for the information system is divided into three areas:

Student information
Parent information
Class information

The information retained on students consists of some identifying information, attendance, tardy and grade information for the current reporting period and cumulative for the semester for each class in which the student is enrolled. The parent information is the address and phone number for the student and the class information consists of the time, title, teacher, and other identifying information on each class offered.

Maintenance of identification information is performed interactively as required. Name, address, counselor and other information changes are entered into the appropriate file through out the year. The student population at this particular high school is quite mobile. For this reason and option was added to drop but not delete a student since students would formally drop from school then reappear a couple of weeks later.

Enrolling students in classes and entry of attendance information is performed through reading in of the mark sense card deck initiated at the beginning of the semester.

Reports

The reporting options grew in response to the expressed needs of the users of the system. Initially the system was designed to provide parents with attendance and progress reports on their students. As a part of providing this to the parents, teacher class lists were needed as well as methods for obtaining summary master listings. As the awareness of the system grew, other people wanted other kinds of reports. As each new request was honored, the new features were integrated into the older capabilities so that each old report option could make use of the new features.

In its current configuration, reports are available in the following forms:

- Parent reports
- Counselor Reports
- Deans Reports
- Teachers Reports

The parent report was the first reason for the CINCH system, and is used to inform parents of their student's progress during the semester. The report is generated in a format designed to fit in a window envelop so that minimal labor is involved in getting the reports mailed to the parents. (See Figure 1)

Counselor and Dean reports are available in the same configurations and are essentially lists of students containing any or all of the following information:

- Name
- Address
- Enrolled classes
- Grades for current period
- Current attendance information
- Cumulative attendance information

In addition, the lists can be generated in order by number of classes (enabling the administrator to follow up on student only enrolled in one or two classes), by low absence honor role (to give praise for good attendance), or by high numbers of failures (to enable administrators to spot students in trouble academically).

Teachers are also given a report of the status of their class at the end of each reporting period which gives them the total and current attendance and tardy figures as well as a list of the students currently enrolled in their class (See Figure 2).

CENTRAL HIGH SCHOOL

O

PARENTS OF FARLEY REGRET
3334 SAN GABREAL AVE
SAN FRANCISCO, CALIF. 94334

****

REGRET, FARLEY
ATTENDANCE REPORT FOR MARCH 9TH TO MARCH 29TH (15 DAYS)

PD	COURSE	ABSENCES	TARDIES	GRADE
1	183 PHYS ED	8	0	F
2	28 AMERICAN LIT	15	0	U
3	100 US HIST 1	8	0	F
4	346 CHORUS	10	0	F
5				
6	316 FOODS	9	0	U
7	229 SCI SUR MINI	13	0	F
8				

IF YOU HAVE ANY QUESTIONS ABOUT THIS REPORT PLEASE CALL
MRS FAWNE AT 239-6200 EXT 5

FIGURE 1 Sample CINCH Report to Parent

REPORTING PERIOD MARCH 9TH TO MARCH 29TH (15 DAYS)

CLASS REPORT US HIST 2 WITZMAN 3106

		ABSENCE TOT	ABSENCE CUR	TARDIES TOT	TARDIES CUR	GRADE
798	ARTUR, CINDY	18	9	1	0	F
116	BROWN, MARY	27	15	0	0	F
799	BURNMORE, GEORGE D	2	1	4	2	S
758	CARTER, TRICIA G	26	15	0	0	F
1394	JINKS, ROBERT	11	3	12	8	U
1003	LAUP, SHARON	3	2	1	0	S
14	LEWIS, RITA	9	8	0	0	F
412	LOWE, CLARENCE E	7	5	1	0	U
537	LUMIS, DENNY	25	13	2	0	F
815	MACK, GERALD N	9	8	0	0	S
676	MCLOVE, SYLVIA	1	1	4	3	S
19	MICESON, CATALAGA	7	2	1	0	S
817	MUTTON, DARYL	1	1	0	0	S
1026	PERRY, JAMES L	10	5	2	1	U
1623	PORT, STORMY E	10	7	8	1	U
870	ROLLIN, A LONG	4	1	0	0	S
419	SAMPAM, BURDETTE S	8	2	0	0	S
872	SMITH, WAYNE	1	1	4	3	S
423	TEEKS, RICH	0	0	1	1	S
1349	WILLIAMS, CATHY M	3	1	1	1	S
1547	WILLIAMS, CATHY R	4	1	0	0	S
1351	YOUNG, SHARON	5	2	8	7	U

TOTAL IN CLASS = 22

DAILY TOTALS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
TARDY	0	2	1	4	1	0	1	2	1	7	3	2	4	1	1
ABSENT	8	6	14	5	6	10	12	9	10	14	13	7	6	5	5

FIGURE 2. Sample CINCH Class List

Statistics

A natural consequence of detailed data on student's school attendance is that statistics can be generated Figure 3 indicates one of the statistical reports generated A lot of information on time of day, grade level and even sex as related to absences is there This figure is included to indicate the nature of the absentee problem at this high school and why the effort in developing a locally maintained system was so worth while. The student population was too fluid to allow the normal inertia of central office data processing to be effective in identifying students with problems or to indicate patterns of difficulty

Ease of programming and the on-line nature of the system meant that statistics could be produced on request as they often were The next section, in the discussion of average daily attendance, illustrates this.

USES OF CINCH

Many of these uses were already indicated in the descriptive section. In this section, however, we will highlight some of the impact of the most valuable uses as the system developed

Reporting to Parents

Figure 2 is a sample parent report This feature was the reason for starting the CINCH project and proved most rewarding The secondary school has a high absentee rate and many parents had been concerned. By the time midterm and final reports got home it was too late for parental action for that semester .Bi-weekly and monthly reports could help

PERIOD COVERED MARCH 9TH TO MARCH 29TH (15 DAYS)

STUDENT COUNTS BY SEX, GRADE AND PERIOD

CURRENT ABSENT COUNTS AND PERCENTAGES

PERIOD	1	2	3	4	5	6	7	8
ALL STUDENTS	5314	4402	4585	3127	2625	5035	4644	1094
DAILY AVERAGES	354 3	293 5	305 7	208 5	175 0	335 7	309 6	72 9
PER STUDENT PERCENT	30 0%	25 4%	25 7%	29 1%	37 3%	30 1%	28 7%	30 1%
MALE TOTAL	2991	2424	2405	1574	1518	2707	2479	466
DAILY AVERAGES	199 4	161 6	160 3	104 9	101 2	180 5	165 3	31 1
PER STUDENT PERCENT	32 7%	26 8%	26 4%	29 5%	37 6%	30 9%	30 7%	32 0%
FEMALE TOTAL	2201	1817	2019	1482	993	2115	1986	622
DAILY AVERAGES	146 7	121 1	134 6	98 8	66 2	141 0	132 4	41 5
PER STUDENT PERCENT	27 1%	23 0%	24 3%	28 7%	36 0%	28 1%	25 9%	29 4%
MALE 10TH GRADERS	1472	1132	1176	641	993	1339	1451	152
DAILY AVERAGES	98 1	75 5	78 4	42 7	66 2	89 3	96 7	10 1
PER STUDENT PERCENT	36.2%	28 2%	29 7%	35 6%	43.6%	34 7%	39 3%	37 5%
MALE 11TH GRADERS	991	833	767	510	421	929	765	166
DAILY AVERAGES	66 1	55 5	51 1	34 0	28 1	61 9	51 0	11 1
PER STUDENT PERCENT	30 6%	26 3%	23 3%	25 4%	31 9%	28 9%	26 2%	24 1%
MALE 12TH GRADERS	496	438	423	410	90	419	248	148
DAILY AVERAGES	33 1	29 2	28 2	27 3	6 0	27 9	16 5	9 9
PER STUDENT PERCENT	27 6%	23 9%	23 3%	27 1%	21 4%	25 2%	17 0%	41 1%
FEMALE 10TH GRADERS	921	825	912	530	524	1044	936	109
DAILY AVERAGES	61 4	55 0	60 8	35 3	34 9	69 6	62 4	7 3
PER STUDENT PERCENT	28 8%	25 2%	27 6%	29 9%	41 6%	33 1%	29 2%	23 4%
FEMALE 11TH GRADERS	846	561	648	427	332	688	708	324
DAILY AVERAGES	56 4	37 4	43 2	28 5	22 1	45 9	47.2	21 6
PER STUDENT PERCENT	31 2%	21 7%	24 0%	27 9%	36 3%	27 1%	26 1%	37 2%
FEMALE 12TH GRADERS	409	411	443	525	110	367	334	189
DAILY AVERAGES	27 3	27 4	29.5	35 0	7 3	24 5	22.3	12 6
PER STUDENT PERCENT	18 7%	20 4%	19 6%	28 2%	19 8%	20 2%	19 4%	24 2%

FIGURE 3 Sample Statistical Report

The response by parents after the CINCH reports were mailed was quite positive If nothing else, it reminded them keep in touch with the school The phone calls to school increased so much that a line was added to the report giving the correct phone number for a parent to call for his student's counselor This helped decrease the problems of the school switch board in trying to route calls to the correct party

Reports to Counselors & Deans

The Counselors and Deans thought little of the system when it was first implemented It was a good idea, to be sure, but had little to do with them But first one, then another saw a possible use for some of the information contained in the data lists of students failing classes was one immediate need which CINCH satisfied If students who were in real academic trouble could be reached early enough in the semester then they could possibly be helped

Another report in response to a need was the list of students taking less than a normal load of classes As the attendance statistics indicated students were not always enrolled for a full number of classes Some had as few as one class, some, who had been in school the preceeding semester, had no classes. Identifying and helping these students early in the semester was important and a CINCH report giving that information was devised literally overnight

SUMMARY ADA INFORMATION

REPORTING PERIOD MARCH 9TH TO MARCH 29TH
(15 DAYS)

COUNTS BASED ON MINIMUM ABSENCE SEARCH

GRADE	N	ABSENCES	DIFF FROM 3RD PD	
10TH	520	1272	1082	2080
11TH	415	719	761	1373
12TH	296	338	560	874
NONE	80	439	72	250
TOTAL	1231	2329	2343	4327

TOTALS FROM ABOVE TRANSLATED INTO ADA MONEY
(RATE IS 176 DAYS = $125.00)

GRADE	N	ABSENCES	DIFF FROM 3RD PD	
10TH	520	$ 903 41	$ 725 85	$1477 27
11TH	415	$ 510 65	$ 540 48	$ 975 14
12TH	296	$ 240 06	$ 397 73	$ 620 74
NONE	80	$ 311 79	$ 51 13	$ 177 56
TOTAL	1231	$1654 12	$1664 06	$3073 15

FIGURE 4 Sample ADA Report

Average Daily Attendance (ADA)

One of the most important features of the system was developed in response to the school attendance office wondering if CINCH couldn't help them with their task At this school attendance for ADA purposes was taken during third period In checking the statistics (see Figure 1) it was found that third period was not when the greatest number of students were present Second period seemed to have that honor Moreover, third period was an arbitrary choice Any period could be chosen In fact, if a student showed up at any class he was there for the day for ADA purposes

A feature was added to CINCH to calculate ADA reporting figures taking the minimum number of times a student was reported absent as the figure for the state ADA report Figure 4 indicates the results of such a calculation for one 15 day period in March, 1973

The money recovered by this reporting method more than justified the cost of the computer system (even though this was never an issue) It was a small trick for the data was in the system anyway, but it was an easily understood demonstration of the utility of the CINCH project and of the computer system itself

IMPLICATIONS OF CINCH

CINCH was begun in response to the request of a school administrator by people keenly interested in maximizing the utility (and cost effectiveness) of small timesharing systems in the schools The capital cost of CINCH was very small The personnel responsible were already involved in the activities of the EDP Resource Center or of the school

As a model of what can be accomplished when a small timesharing system is used to its fullest CINCH adds a very positive dimension The recovered average daily attendance (ADA) money more than offset (on paper, of course) the cost of the hardware This meant that a case for a small, school centered timesharing system could be made in an additional way

Ordinarily, educational justifications are used to support such applications Such justifications, while appealing, can be defeated by cost conscious critics who argue that the money just isn't there By being able to offer a second case - one which states money can be saved or made through administrative applications of the system - the system can be presented as appealing to all sides

CINCH runs without noticeable impact on the primary mission of the EDP Resource Center's Hewlett-Packard 2000F System That mission is instruction and a corner stone in the implementation of CINCH was that it not interfer with the instructional uses of the system During the development of the CINCH project there was some interference as deadlines and disasters occurred together but this did not happen when the system settled into full and routine operation

In summary, CINCH has proven worth while for administrators because it placed a substantial information tool literally at their finger tips and it has proven to be worth while from the stand point of the educational users because it provides, at no sacrafice to the instructional applications, an additional dimension for cost justification